United States
Department of
Agriculture

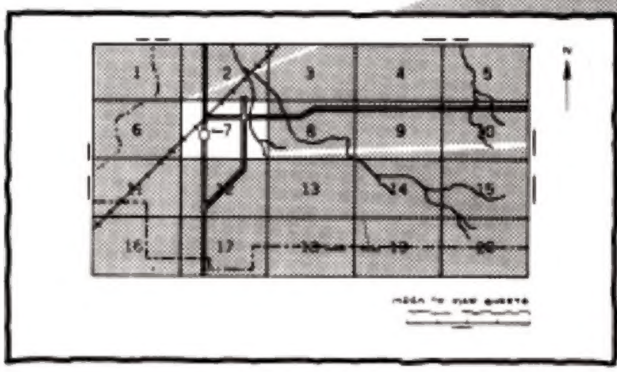
Soil
Conservation
Service

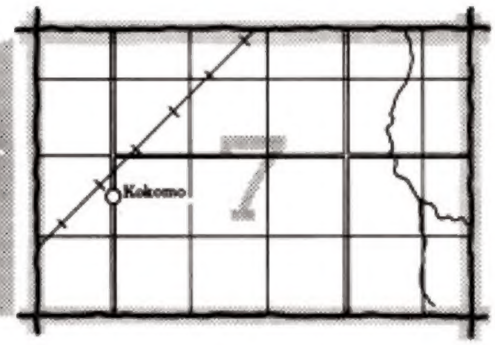
In cooperation with
Oklahoma Agricultural
Experiment Station
and Oklahoma
Conservation Commission

Soil Survey of Harmon County, Oklahoma

HOW TO USE

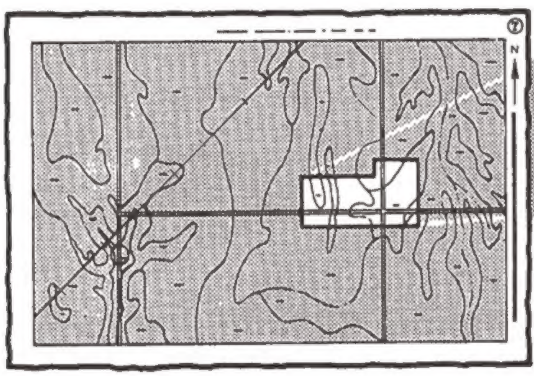
1. Locate your area of interest on the "Index to Map Sheets"

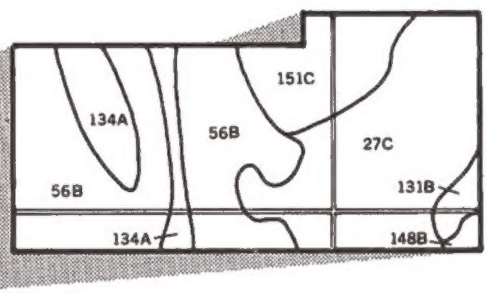




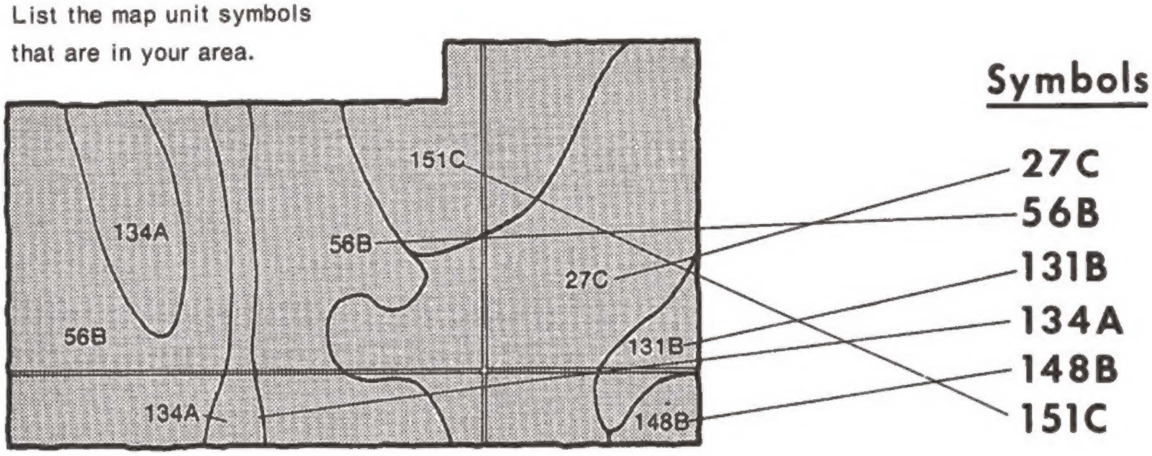
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



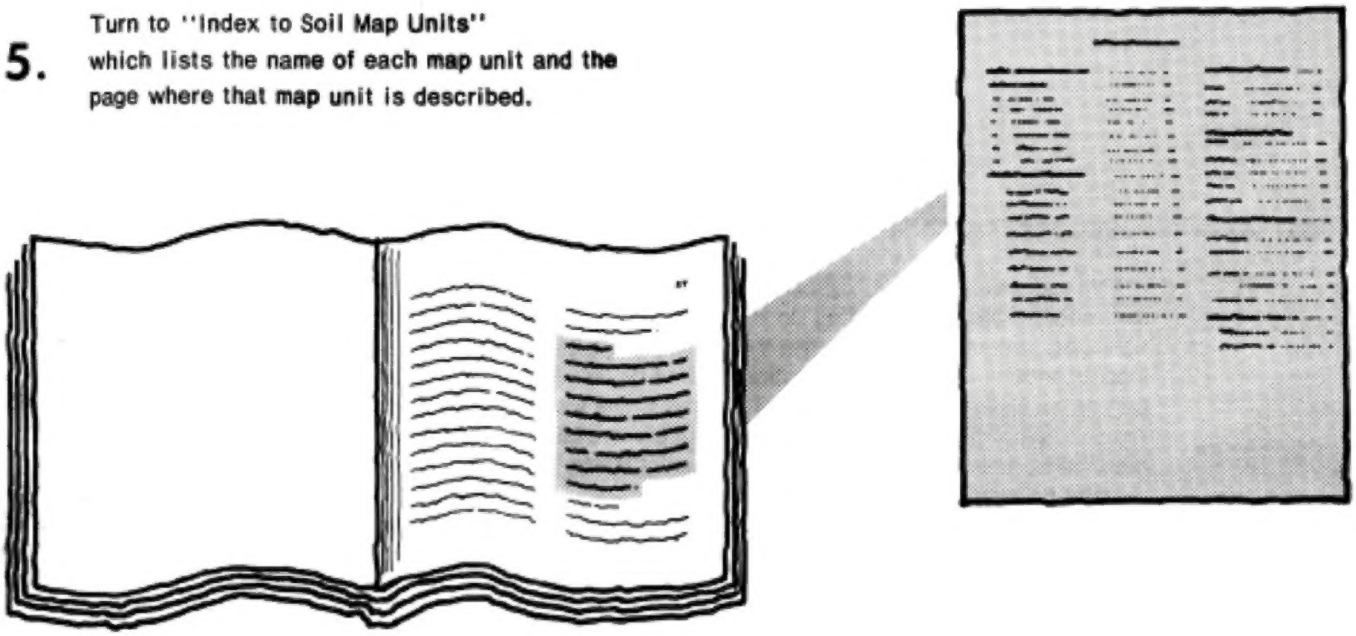


4. List the map unit symbols that are in your area.

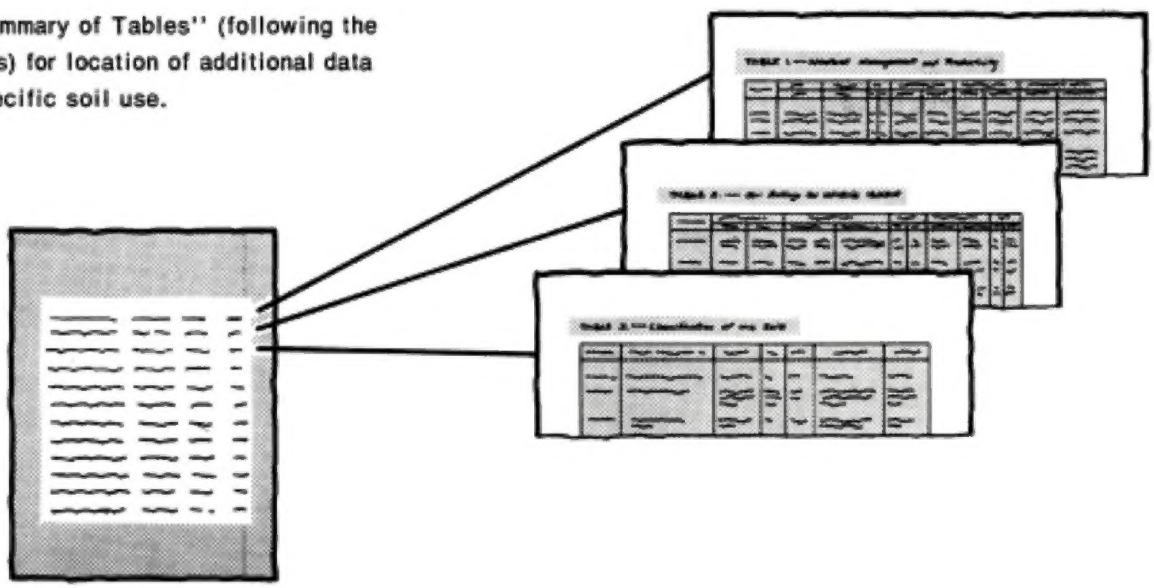


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in 1981. Soil names and descriptions were approved in 1982. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1982. This survey was made cooperatively by the Soil Conservation Service, the Oklahoma Agricultural Experiment Station, and the Oklahoma Conservation Commission. It is part of the technical assistance furnished to the Harmon County Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Aerial view of field terraces and grassed waterway on Woodward and Quinlan soils.

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Soil Series

Issued September 1984

Index to Map Units

Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Harmon County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Roland R. Willis

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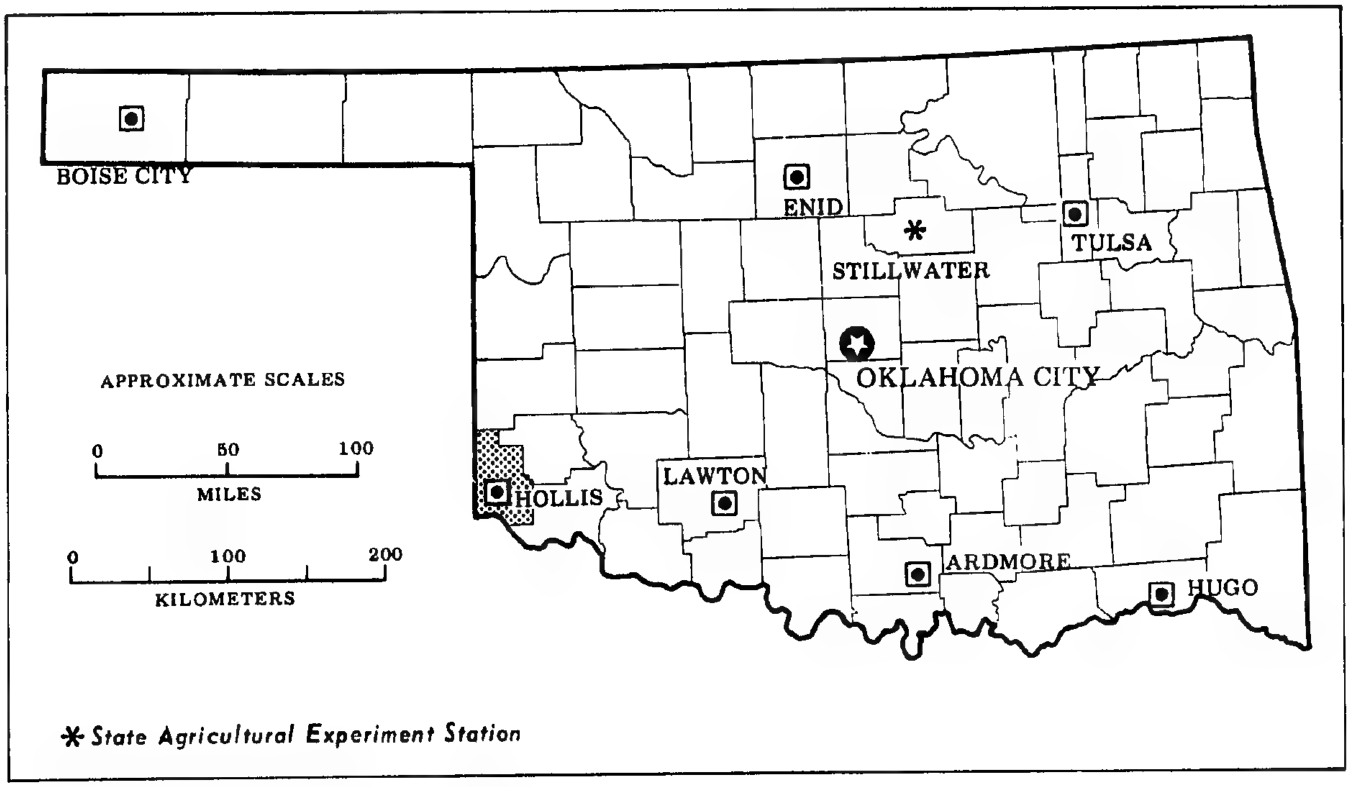
State Conservationist
Soil Conservation Service



Location of Harmon County in Oklahoma.

Soil Survey of
Harmon County, Oklahoma

By Jimmy G. Ford, R. Clay Wilson, and Gregory F. Scott,
Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service
in cooperation with
Oklahoma Agricultural Experiment Station and
Oklahoma Conservation Commission

Harmon County is in the southwestern part of Oklahoma. It is about 348,000 acres or 545 square miles in area. Of this, water areas of more than 40 acres make up about 9,690 acres. The population of the county is 4,519. This includes Hollis, the county seat, which has a population of 2,958.

Harmon County is bordered on the north by Beckham and Greer Counties; on the east by Greer and Jackson Counties; on the west by Collingsworth and Childress Counties, Texas; and on the south by Jackson County, Oklahoma, and Hardeman County, Texas.

General Nature of the Survey Area

This section discusses the climate, settlement and development, relief and drainage, natural resources, and visual resources of Harmon County.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

In Harmon County, winter is alternately mild and very cool. Cold fronts repeatedly sweep over the county, causing sharp drops in temperature, but the cold air behind these fronts moderates quickly. Summers are hot. Precipitation in winter, commonly snowfall, is light. Total annual precipitation generally is adequate for the production of wheat, sorghum, and range grasses.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Hollis in the period 1951 to 1974. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 42 degrees F, and the average daily minimum temperature is 27 degrees. The lowest temperature on record, which occurred at Hollis on January 23, 1966, is -10 degrees. In summer the average temperature is 83 degrees, and the average daily maximum temperature is 97 degrees. The highest recorded temperature, which occurred on June 14, 1953, is 117 degrees.

Growing degree days are shown in table 3. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 22.03 inches. Of this, 16 inches, or 70 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 12 inches. The heaviest 1-day rainfall during the period of record was 4.76 inches at Hollis on August 27, 1979. Thunderstorms occur on about 48 days each year, and most occur in summer.

The average seasonal snowfall is 8.5 inches. The greatest snow depth at any one time during the period of record was 8 inches. On an average of 2 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 50 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 75 percent of the time possible in summer and 65 percent in winter.

The prevailing wind is from the south. Average windspeed is highest, 14 miles per hour, in April.

Occasional duststorms occur in spring, when strong dry winds blow over unprotected soils. Tornadoes and severe thunderstorms, some with hail, occur occasionally. These storms are local and of short duration, and the pattern of damage is variable and spotty.

Settlement and Development

A few settlers and cattlemen moved into the survey area in about 1850. Before this the area was used by Comanche Indians for hunting. The area was a part of the Louisiana Territory purchased by the United States in 1803. It was granted to Oklahoma Territory in 1891 by an act of the Supreme Court and became a part of Greer County. The city of Hollis had its beginning in 1893 when a general store was built in the area. In June of 1897, unoccupied land in the area was opened for settlement. In 1909, Harmon County was separated from Greer County.

In 1910, the reported population of the county was 11,329. After World War I practically all of the tillable land was plowed and planted. By 1930 the population had grown to 13,834. The drought and depression of the 1930's and drought of the 1950's caused many people to move from the county. By 1970, the population had declined to 5,136, and by 1980 the estimated population was 4,519.

Use of the area for farming and ranching began in about 1850. After the area was opened for settlement in 1897, farmers began to break out the land for clean-tilled crops. Wheat, cotton, corn, and grain sorghum were the main crops. After the drought of the 1930's, much of the less productive cropland was reseeded or reverted naturally to native grasses. That trend continues, and some cropland is converted each year to native and tame grasses. Development of irrigation wells near Hollis began in the 1950's. The main irrigated crops are cotton, wheat, and alfalfa. The development of irrigation is continuing, and more productive soils are being used for irrigated crops.

About 40 percent of the county is rangeland and the other 60 percent includes cropland, pastureland, and urban land. The major crops are wheat and cotton, followed by grain sorghum and alfalfa. Improved pasture makes up about 3 percent of the county.

Relief and Drainage

The county is in the Rolling Red Plains resource area. The Red River borders the southwest corner of the county. The Elm Fork of the Red River and the Salt Fork of the Red River cross the county. Lebos, Sandy, Turkey, Grape, and Cave Creeks drain the largest portion of the county. Major flooding occurs on Lebos, Sandy, and Turkey Creeks. Turkey Creek is protected from flooding by the Tri-County Turkey Creek Watershed Project. Frequent flooding along Sandy Creek and Lebos Creek causes extensive damage to cultivated crops.

The relief in Harmon County is dominantly nearly level to gently sloping uplands. A large area of nearly level to gently sloping upland is in the central and southeastern parts of the county. The northern part of the county associated with the Elm Fork of the Red River and the lower part of Cave Creek is rocky uplands deeply cut by canyons and gullies. Uplands associated with Grape Creek, the upper part of Cave Creek, and the Salt Fork of the Red River are rolling hills that have narrow ridgetops, long, sloping to steep side slopes, and narrow drainageways. The Salt Fork of the Red River has a sandy terrace to the south that has low rolling hills intermingled with long narrow flats.

Turkey Creek has a wide flood plain. The upland is broad ridgetops that have wide gently sloping to moderately steep side slopes. The upper part of Turkey Creek has severely eroded side slopes. Sandy Creek and its tributary, Lebos Creek, drain nearly a third of the county. The flood plain is narrow and in many places not clearly defined. The relief of the upland is broad, nearly level to gently sloping. An area of rocky upland is in the southwestern part of the county. It is broad, very gently sloping to sloping and has sloping to steep side slopes and narrow drainageways.

Elevation ranges from 1,500 feet in the south-central part of the county, where the Red River leaves the county, to 2,060 feet in the northwestern part of the county.

Natural Resources

Productive soils and suitable, available irrigation water are the most important natural resources in the county. A large acreage of soils in the county is productive and has high potential for growing native grasses, cotton, wheat, grain sorghum, bermudagrass, weeping lovegrass, and other crops. Rangeland makes up about 40 percent of the county. Although much of the rangeland and cropland has been damaged by erosion and overgrazing in the past, proper management can help increase production of native grasses and crops.

The sandy area lying immediately south of the Salt Fork of the Red River has a good underground water supply that is being used as a water source for Hollis, Gould, and local rural water districts. This water source provides water for sprinkler irrigation on a few farms. A large area around Hollis has an underground water supply that is used for irrigation. This water supply is from gypsum caverns 100 to 300 feet below ground level. Because of dissolved salts, good water management is needed for the maximum production of irrigated crops.

Other resources include beds of gypsum in the northern part of the county. These deposits are large

enough to be worked, but it is not economical at this time. Several gas wells have been drilled throughout the county, but none have produced commercial quantities of natural gas. Petroleum production is gaining importance in the county, with the discovery and development of an oilfield in the southeastern part of the county.

Visual Resources

David Thompson, landscape architect, Soil Conservation Service, assisted in the preparation of this section.

The visual resource or aesthetic quality of the landscape of Harmon County is important to the inventory, evaluation, and management of the soils. The visual resource is the appearance of the landforms, vegetation, water elements, and manmade structures. These features in the landscape occur in various patterns, and the visual resource can be defined in degrees of diversity ranging from low to high. The visual resources in Harmon County are finite and should be properly managed for effective conservation.

Each general soil map unit has a distinctive appearance that can be modified by changing the landscape elements or their patterns. In some areas, the visual resource has been extensively changed by agricultural practices or urban expansion.

In the descriptions of the general soil map units, the visual diversity is explained and rated. These descriptions are based on a comparison of landscapes and the patterns created by the basic landscape features, mainly vegetation, landform, water elements, and manmade structures.

The landscape features and patterns are readily visible, and the diversity of the landscape can be rated as high, medium, or low. A landscape that has high visual diversity has some or all of the following characteristics: variations in landforms; unique plant communities; varied vegetative patterns; high clarity in rivers, or streams, or in both; diverse shorelines on lakes or ponds; and harmonious appearance of manmade structures with the landscape and other structures. In areas of low visual diversity, one landscape element may be dominant and can create a continuous appearance with little or no contrast in pattern. Low diversity areas may have some of the following characteristics: landforms that do not have variety; vegetative cover that does not have variation in type, height, or color; water bodies that have limited visual interest or do not have variety in shorelines; and manmade structures that are not related to their surroundings.

When one is evaluating a change in landscape elements and patterns, the potential impacts on the visual resources should be carefully analyzed. Commonly, a single practice may increase or decrease the visual resource quality of an area. For example, the grading and revegetating of an eroded area increases the visual resource quality. A decrease in visual resource quality can occur when the soil behavior of an area is not taken into consideration. For instance, an area of sloping soil suited to woodland may be cleared and planted to row crops. A knowledge of soil behavior and management is needed to properly evaluate the effect of row cropping on the landscape. The soil may erode severely during winter if not protected by vegetative cover. A severely eroded soil would decrease the visual resource quality and result in bare unsightly eroded areas, loss of soil, decrease in water quality due to silt load, and loss of other vegetative areas due to increased runoff.

A knowledge of each map unit and the result that land use changes have is necessary to effectively plan for proper management. Assistance for resource planning is available from the Soil Conservation Service field office in Harmon County. Proper consideration of soil factors, land use, and the visual elements helps to enhance and preserve the optimum quality of the area.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another resulting in gradual changes in characteristics. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the

soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources (*6*), such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed, and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soils on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation to precisely define and locate the soil is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Deep, Somewhat Poorly Drained to Somewhat Excessively Drained, Sandy, Loamy, and Clayey Soils on Flood Plains

These two soils make up about 5.8 percent of Harmon County. The areas are used mainly for range, tame pasture, and hay but a significant acreage is used for cultivated crops.

1. Yahola-Lincoln-Gracemore

Deep, nearly level, well drained, somewhat excessively drained, and somewhat poorly drained, loamy and sandy soils that formed in sandy or loamy alluvium

This map unit consists of nearly level soils on flood plains along the Prairie Dog Town Fork of the Red River, Salt Fork of the Red River, Elm Creek, and some of the major drainageways within the county. Slope is 0 to 1 percent.

Visual diversity in this unit is medium. Landforms are nearly level and are not prominent. Vegetative patterns are mainly woody species, cottonwood, tamarack, willow, and sagebrush. Water elements are streambeds which become dry during the droughty part of summer. Manmade structures in this unit are not common because of frequent flooding.

This map unit makes up about 3.6 percent of the county. It is about 33 percent Yahola soils, 19 percent Lincoln soils, 17 percent Gracemore soils, and 31 percent soils of minor extent.

Yahola soils are on the flood plain. They are at a slightly higher elevation than the Lincoln soils. These soils are deep, nearly level, and well drained. Most areas are subject to occasional flooding for very brief periods, but some areas are rarely flooded. Typically, the Yahola soils have a surface layer of reddish brown fine sandy loam. The underlying material is reddish brown fine sandy loam that has thin strata of loam, silt loam, and loamy fine sand.

Lincoln soils are on the flood plain adjacent to the stream channel. They are at a lower elevation than Yahola soils. These soils are deep, nearly level, and somewhat excessively drained. Areas are subject to frequent flooding that lasts for very brief periods. Typically, the Lincoln soils have a surface layer of light brown loamy fine sand. The underlying material is light brown loamy fine sand and pink fine sand that has thin strata of very fine sandy loam, fine sandy loam, loamy sand, and loamy fine sand.

Gracemore soils are generally on the outer edges of the flood plains or along old river channels that have been cut off from the major channel. They are deep, nearly level, and somewhat poorly drained. These soils are slightly or moderately affected with saline salts. They have a water table that fluctuates from near the surface to a depth of about 40 inches. Areas are subject to frequent flooding that lasts for very brief periods. Typically, the Gracemore soils have a surface layer of light reddish brown loam. The underlying material is light brown loamy fine sand that has thin strata of fine sandy loam.

Of minor extent are the well drained Clairemont soils, the somewhat poorly drained Gracemont soils, and the excessively drained Likes soils. The Gracemont soils have a water table within a depth of 40 inches most of the year and are affected with saline salts.

Areas of this map unit are used mainly for range. Some areas are used for tame pasture, hay, and cultivated crops. Cotton and wheat are the main cultivated crops. The major management concerns are flooding, soil erosion, and maintaining soil structure and fertility.

The soils have high potential for range and tame pasture and hay. Potential is high for cultivated crops on Yahola soils and low on Lincoln and Gracemore soils.

The potential is low for sanitary facilities and building sites, medium for most recreational uses, and high for wildlife habitat. For uses in which the potential is medium or low, the hazard of flooding and the sandy surface layer in the Lincoln soils are the main limitations.

2. Mangum-Spur

Deep, nearly level, well drained, clayey and loamy soils that formed in clayey or loamy alluvium

This map unit consists of nearly level soils on flood plains along Turkey Creek, Elm Creek, and their tributaries. Slope is 0 to 1 percent.

Visual diversity in this unit is medium. Landforms are nearly level and typically smooth. Patterns of vegetation are varied. Vegetation is native grasses and bottom land trees and shrubs. Water is generally present in streambeds, except during dry periods in the summer. Manmade structures in this unit are not common.

This map unit makes up about 2.2 percent of the county. It is about 45 percent Mangum soils, 43 percent Spur soils, and 12 percent soils of minor extent.

Mangum soils are on the flood plains. They are generally at a slightly higher elevation than the Spur soils. These soils are deep, nearly level, and well drained. Areas are subject to rare or occasional flooding that lasts for very brief periods. Typically, the Mangum soils have a surface layer of red silty clay loam. The subsoil is red clay. The underlying material is red clay and has thin strata of loam and fine sandy loam. In some areas, the surface layer is reddish brown silty clay.

Spur soils are on the flood plain in narrow areas adjacent and parallel to the stream channel. They are at a lower elevation than Mangum soils. These soils are deep, nearly level, and well drained. Areas are subject to frequent or occasional flooding that lasts for very brief periods. Typically, the Spur soils have a surface layer of brown clay loam. The subsoil is dark yellowish brown or reddish brown clay loam. The underlying material is reddish brown clay loam and has thin strata of sandy loam.

Of minor extent are the well drained Clairemont, Beckman, and Yahola soils.

Areas of this map unit are used mainly for cultivated crops. Some areas are used for tame pasture, hay, and range. Small grains, cotton, and grain sorghum are the major crops. The major management concerns are flooding, controlling grazing, controlling brush and weeds, and maintaining soil fertility and structure.

These soils have high potential for range, tame pasture, and hay. Potential is medium for cultivated crops and low for sanitary facilities and building sites. Potential is low for most recreational uses and high for wildlife habitat. Flooding, clayey texture, shrinking and swelling, and the very slow permeability in the Mangum soils are the main limitations.

Deep to Shallow, Well Drained, Loamy and Sandy Soils on Uplands

These soils make up about 46.6 percent of Harmon County. The areas are used mainly for cultivated crops but a significant acreage is used for tame pasture, hay, and range.

3. Grandfield-Devol

Deep, nearly level to strongly sloping, well drained, sandy and loamy soils that formed in sandy and loamy deposits

This map unit consists of nearly level to strongly sloping soils on smooth to hummocky uplands mainly in the central part of the county. These soils formed in old alluvial or eolian sediments that mantle the higher lying uplands. Slope ranges from 0 to 12 percent.

The visual diversity in this unit is medium. Landforms are moderately diverse. The irregular topography is nearly level to strongly sloping and hummocky. Vegetation is generally cultivated crops with some scattered stands of trees along fence rows and drainageways. Water elements are limited to drainageways. Manmade structures in this unit are primarily farmsteads.

This map unit makes up about 19.8 percent of the county. It is about 34 percent Grandfield soils, 32 percent Devol soils, and 34 percent soils of minor extent.

Grandfield soils generally are at a lower elevation than the Devol soils. They are deep, very gently sloping to gently sloping, and well drained. Typically, the Grandfield soils have a surface layer of light brown or brown loamy fine sand or fine sandy loam. The subsoil is reddish brown fine sandy loam and sandy clay loam in the upper part and yellowish red sandy clay loam and fine sandy loam in the lower part.

Devol soils are on convex, hummocky uplands and side slopes. They generally are at a higher elevation than the Grandfield soils. These soils are deep, nearly level to strongly sloping, and well drained. Typically, the Devol soils have a surface layer of reddish brown loamy fine sand or fine sandy loam. The subsoil is yellowish red fine sandy loam and loamy fine sand. The underlying material is yellowish red loamy fine sand.

Of minor extent in this map unit are the well drained Abilene, Altus, Grandmore, Hardeman, McKnight, and Nobscot soils on uplands. The Gracemont, Lincoln, and Yahola soils are on flood plains of streams that transverse the map unit.

Most areas of this map unit are used for common cultivated crops, such as small grains, cotton, grain sorghum, and peanuts and for specialty crops, such as mungbeans and guar. Some areas are used for tame pasture, hay, and range. The major concerns of management are controlling wind and water erosion,

controlling brush and weeds, protecting the grasses from overgrazing, and maintaining soil structure and fertility.

These soils have medium potential for cultivated crops, tame pasture, hay, and range. Potential is high for most sanitary facilities, building sites, urban uses, and recreational uses. Potential is medium for wildlife habitat and for playgrounds. Seepage and slope are the main limitations.

4. Woodward-Quinlan

Moderately deep and shallow, very gently sloping to steep, well drained, loamy soils that formed in loamy material weathered from sandstone

This map unit consists mainly of very gently sloping to strongly sloping soils on smooth uplands, but occasional moderately steep or steep soils are along drainageways. Areas of this map unit are mainly in the northern part of the county north of the Salt Fork of the Red River. Slope ranges from 1 to 45 percent.

The visual diversity in this unit is medium. Landforms are gently sloping to sloping and are not prominent. Vegetative patterns are varied and are made up of range, native grasses, and cultivated crops. Water elements are the scattered farm ponds, drainageways, and perennial streams. Manmade structures in this unit are generally farmsteads.

This map unit makes up about 14.0 percent of the county. It is about 45 percent Woodward soils, 33 percent Quinlan soils, and 22 percent soils of minor extent and rock outcrop (fig.1).

Woodward soils are on side slopes on convex uplands. They are moderately deep, very gently sloping to strongly sloping, and well drained. Typically, the Woodward soils have a surface layer of yellowish red and reddish brown red loam. The subsoil is red loam and very fine sandy loam. The underlying material is weakly cemented sandstone.

Quinlan soils are on all positions of the landscape but most commonly are on small knolls and side slopes. They are shallow, very gently sloping to steep, and well drained. Typically, the Quinlan soils have a surface layer of reddish brown loam. The subsoil is red loam. The underlying material is weakly cemented sandstone.

Of minor extent in this map unit are the well drained Carey, Hardeman, Madge, and Shrewder soils on

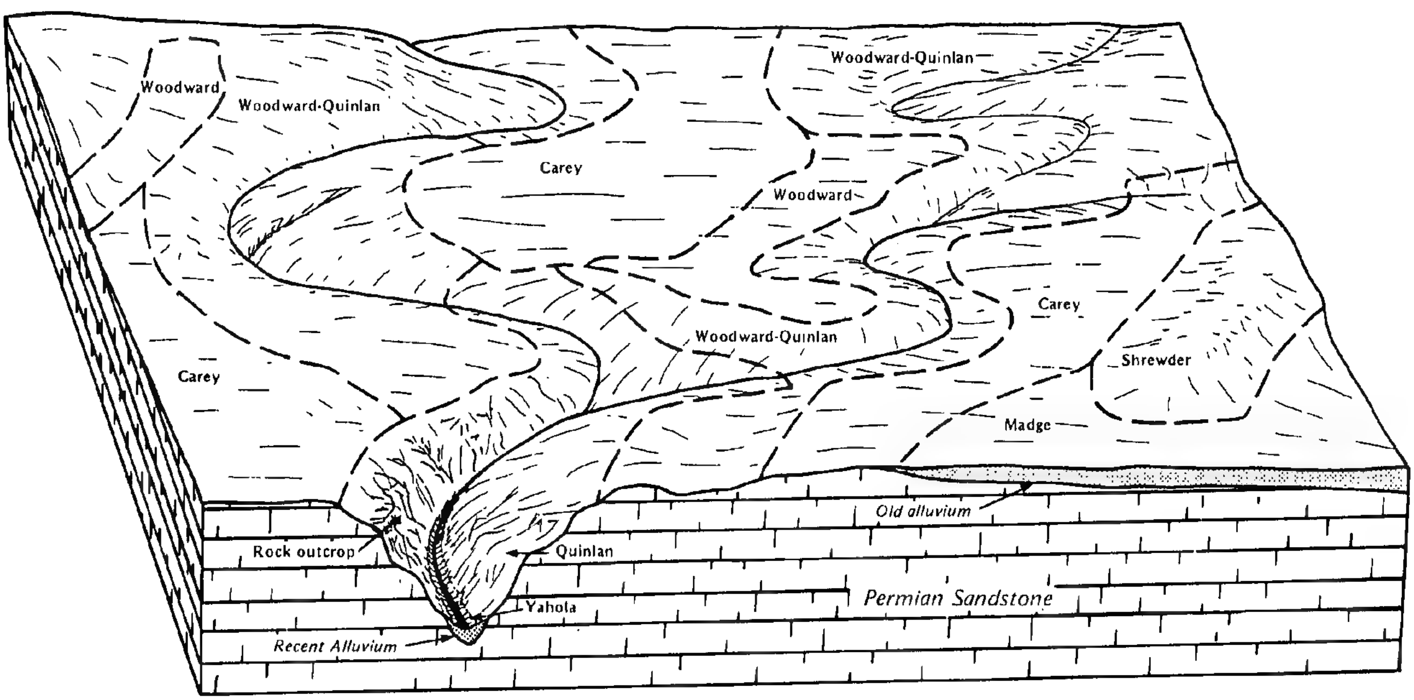


Figure 1.—Typical pattern of soils and underlying material in the Woodward-Quinlan map unit.

uplands. The Clairemont and Yahola soils are on flood plains of streams that transverse the map unit.

Areas of this map unit are used mainly for range, but some areas are used for tame pasture, hay, and cultivated crops. The main crops are small grains, cotton, and grain sorghum. The major management concerns are controlling soil and water erosion, maintaining soil structure and fertility, controlling brush and weeds, and protecting the grasses from overgrazing.

These soils have low potential for cultivated crops, tame pasture, and hay and medium potential for range. Potential is medium for sanitary facilities and building sites, for most recreational uses, and for wildlife habitat. Depth to bedrock and slope are the main limitations.

5. Madge-Abilene-Shrewder

Deep, nearly level to gently sloping, well drained, loamy soils that formed in loamy and clayey old alluvium and eolian sediments

This map unit consists of nearly level to gently sloping soils on smooth concave and convex uplands. These soils are throughout the county. Slope ranges from 0 to 5 percent.

Visual diversity in this unit is low. Landforms are nearly level to gently sloping and are not prominent. Vegetative patterns are somewhat diverse scattered groups of trees along drainageways and in fence rows along cultivated crops. Water elements are limited to drainageways. Manmade structures in this unit will be visually significant, unless they are blended into the existing landscape elements.

This map unit makes up about 7.0 percent of the county. It is about 51 percent Madge soils, 22 percent Abilene soils, 12 percent Shrewder soils, and 15 percent soils of minor extent (fig. 2).

Madge soils generally are on convex slopes. They are generally slightly higher in elevation than the Abilene soils and generally slightly lower than the Shrewder soils. These soils are deep, nearly level to very gently sloping, and well drained. Typically, the Madge soils have a surface layer of reddish brown and dark reddish gray loam. The subsoil is reddish brown clay loam and sandy clay in the upper part and red loam in the lower part. The underlying material is red fine sandy loam.

Abilene soils are on broad flats or concave positions near the head of drainageways on uplands. These soils are deep, nearly level to very gently sloping, and well drained. Typically, the Abilene soils have a surface layer of brown loam. The subsoil is brown clay. The underlying material is light brownish gray clay loam and yellowish red loam.

Shrewder soils are on smooth convex positions. These soils are deep, very gently sloping to gently sloping, and well drained. Typically, the Shrewder soils have a surface layer of reddish brown fine sandy loam. The subsoil is red loam. The underlying material is red very fine sandy loam that is underlain with red, soft sandstone.

Of minor extent are the well drained Acme, Carey, Quinlan, Vinson, and Woodward soils on uplands.

Most areas of this map unit are used for cultivated crops, such as small grains and grain sorghum. Some small areas are used for tame pasture, hay, or range. The major concerns of management are controlling soil and water erosion, maintaining soil structure and fertility, protecting grasses from overgrazing, and controlling brush and weeds.

These soils have high potential for cultivated crops, tame pasture, hay, and range. Potential is high for most sanitary facilities and building sites, for most recreational uses, and for wildlife habitat. Seepage in the Shrewder soils and shrinking and swelling in the Abilene soils are the main limitations.

6. Tipton-Westview-Altus

Deep, nearly level to very gently sloping, well drained, loamy soils that formed in loamy alluvium

This map unit consists of nearly level to very gently sloping soils on smooth concave and slightly convex stream terraces. Areas are along Sandy Creek, Lebos Creek, and Buck Creek in the southern part of the county. Slope ranges from 0 to 3 percent.

The visual diversity in this unit is low. The landforms are nearly level to gently sloping. Vegetative patterns are limited; the majority of vegetation is cultivated crops and occasional grassed waterways. Water elements are generally not significant. Manmade structures in this unit will be visually significant, unless they are blended into the existing landscape elements.

This map unit makes up about 5.8 percent of the county. It is about 53 percent Tipton soils, 18 percent Westview soils, 17 percent Altus soils, and 12 percent soils of minor extent (fig. 3).

Tipton soils are on smooth, broad, slightly convex stream terraces. These soils are deep, nearly level or very gently sloping, and well drained. Typically, the Tipton soils have a surface layer of dark reddish gray loam. The subsoil is dark reddish brown loam and dark reddish gray clay loam in the upper part and reddish brown clay loam and loam in the lower part. The underlying material is yellowish red loam.

Westview soils are on broad, smooth, slightly concave uplands. These soils are deep, nearly level, and well drained. Typically, the Westview soils have a surface layer of reddish brown silty clay loam. The subsoil is reddish brown and light reddish brown silty clay loam. The underlying material is reddish brown silty clay loam.

Altus soils are on smooth, broad convex uplands. These soils are deep, nearly level to very gently sloping, and well drained. Typically, the Altus soils have a surface layer of dark brown and dark reddish brown fine sandy loam. The subsoil is reddish brown fine sandy loam and

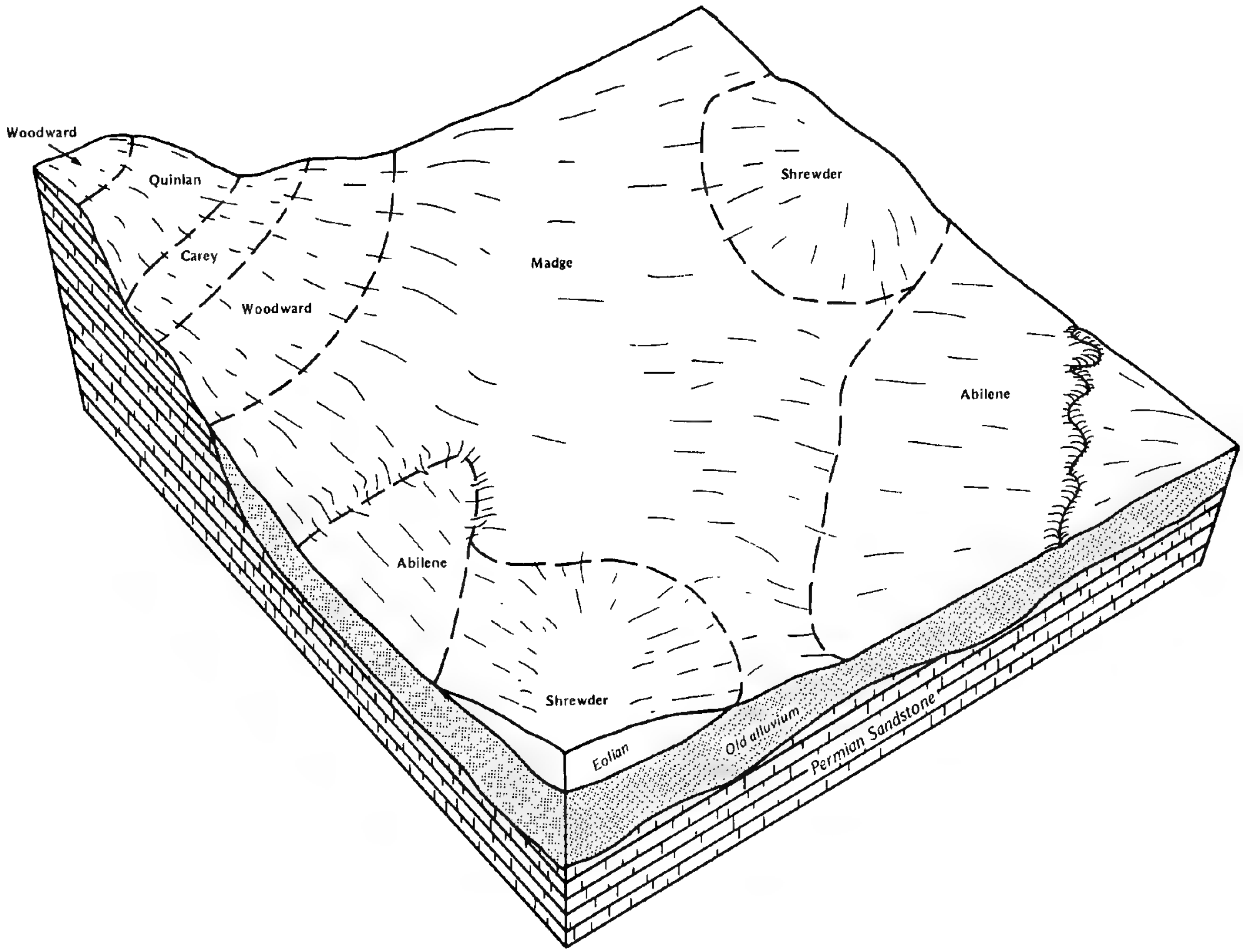


Figure 2.—Typical pattern of soils and underlying material in the Madge-Abilene-Shrewder map unit.

sandy clay loam in the upper part and reddish brown fine sandy loam and sandy clay loam in the lower part.

Of minor extent are the well drained Aspermont, Devol, Grandfield, and Hardeman soils on uplands. The Clairemont, Spur, and Yahola soils are on flood plains of streams that transverse the map unit.

Most areas of this map unit are used for cultivated crops, such as cotton, small grains, and grain sorghum. Some areas are used for tame pasture, hay, or range. The major concerns of management are controlling soil and water erosion, controlling brush and weeds, protecting grasses from overgrazing, and maintaining soil structure and fertility.

These soils have high potential for cultivated crops, tame pasture, hay, and range. Potential is high for most sanitary facilities and for most building sites. Potential is high for recreational uses and wildlife habitat. Shrinking and swelling is a limitation for buildings in the Westview soils, and seepage is a limitation for ponds in the Altus and Tipton soils.

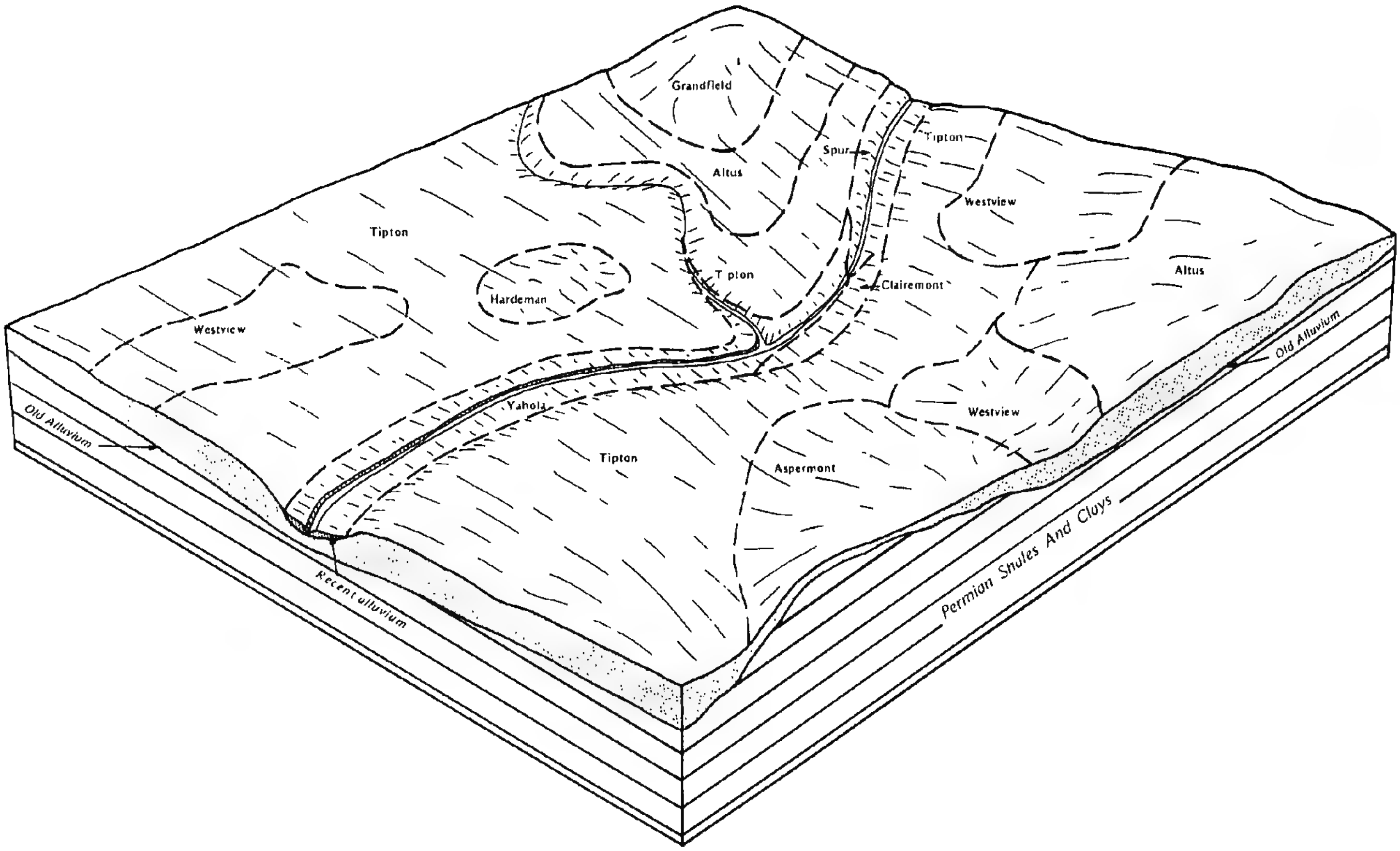


Figure 3.—Typical pattern of soils and underlying material in the Tipton-Westview-Altus map unit.

Very Shallow to Deep, Well Drained to Excessively Drained, Sandy, Loamy, and Clayey Soils on Uplands

These soils make up about 47.6 percent of Harmon County. The areas are used mainly for cultivated crops or range.

7. Tillman-Vernon

Deep and moderately deep, nearly level to strongly sloping, well drained, loamy soils that formed in materials weathered from clay and shale

This map unit consists of areas of soils on smooth, broad uplands, mainly in the southeastern and south-central parts of the county. Slope ranges from 0 to 12 percent.

Visual diversity in this unit is low. The landforms are nearly level to strongly sloping. Vegetative patterns are mainly cultivated crops, the major vegetative cover. Water elements and structures are not significant. Manmade structures will be visually significant, unless they are blended into the existing landscape elements.

This map unit makes up about 22.6 percent of the county. It is about 44 percent Tillman soils, 36 percent Vernon soils, and 20 percent soils of minor extent (fig. 4).

Tillman soils are on smooth, broad, convex uplands. These soils are deep, nearly level to very gently sloping, and well drained. Typically, the Tillman soils have a surface layer of reddish brown and dark reddish brown clay loam. The subsoil is dark reddish gray, reddish brown, and yellowish red clay. The underlying material is yellowish red shale or clay.

Vernon soils are on ridgetops and side slopes of convex uplands. These soils are moderately deep, very gently sloping to strongly sloping, and well drained. Typically, the Vernon soils have a surface layer of reddish brown clay loam. The subsoil is reddish brown and red clay. The underlying material is red, weakly

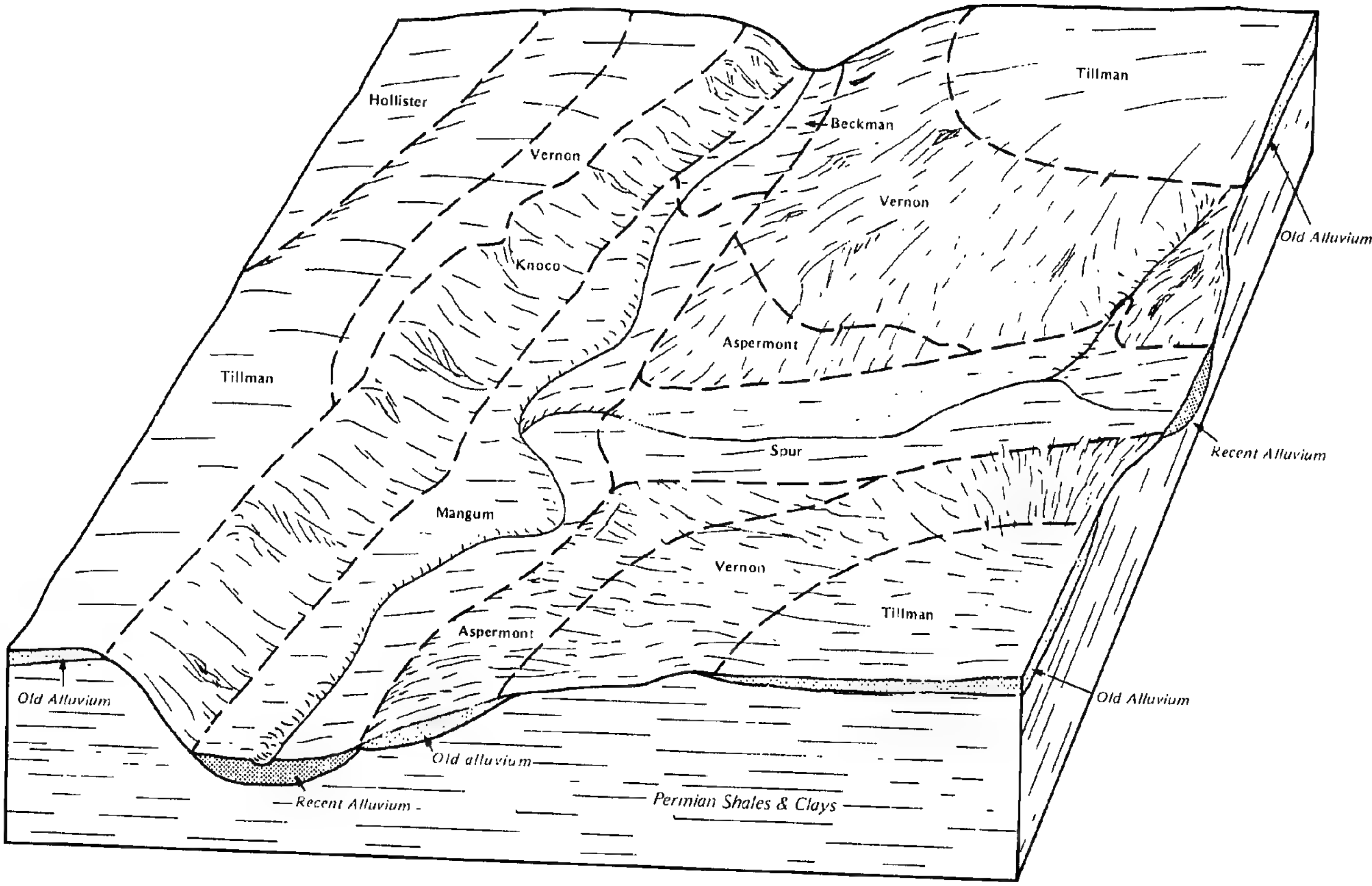


Figure 4.—Typical pattern of soils and underlying material in the Tillman-Vernon map unit.

consolidated shale and has thin strata of blue gray shale.

Of minor extent are the well drained Aspermont, Beckman, Hollister, and Knoco soils on the uplands. The Beckman, Mangum, and Spur soils are on flood plains of streams that transverse the map unit.

Most areas of this map unit are used for cultivated crops, such as small grains, grain sorghum, and cotton. Some areas are used for range, tame pasture, and hay. The major concerns of management are controlling water erosion, controlling brush and weeds, protecting the grasses from overgrazing, and maintaining soil structure and fertility.

These soils have medium potential for cultivated crops and have low to medium potential for range, tame pasture, and hay. Potential is low for most sanitary facilities and building sites. Potential is medium for most recreational uses and wildlife habitat. Slow permeability and shrinking and swelling are the main limitations.

8. Knoco-Vernon-Cornick

Very shallow to moderately deep, very gently sloping to steep, well drained or excessively drained, clayey and loamy soils that formed in materials weathered from shale and gypsum

This map unit consists of very gently sloping to steep soils on uplands throughout the county. Slope ranges from 1 to 40 percent.

The visual resource quality in this unit is high. Landforms are very gently sloping to steep and variable. Vegetative patterns are mainly in the rangeland. Manmade structures or changes in this unit will not be visually significant because of the landscape diversity.

This map unit makes up about 19.5 percent of the county. It is about 22 percent Knoco soils, 17 percent Vernon soils, 7 percent Cornick soils, and 54 percent soils of minor extent (fig. 5).

Knoco soils are on narrow ridges and side slopes on convex uplands. These soils are very shallow, very

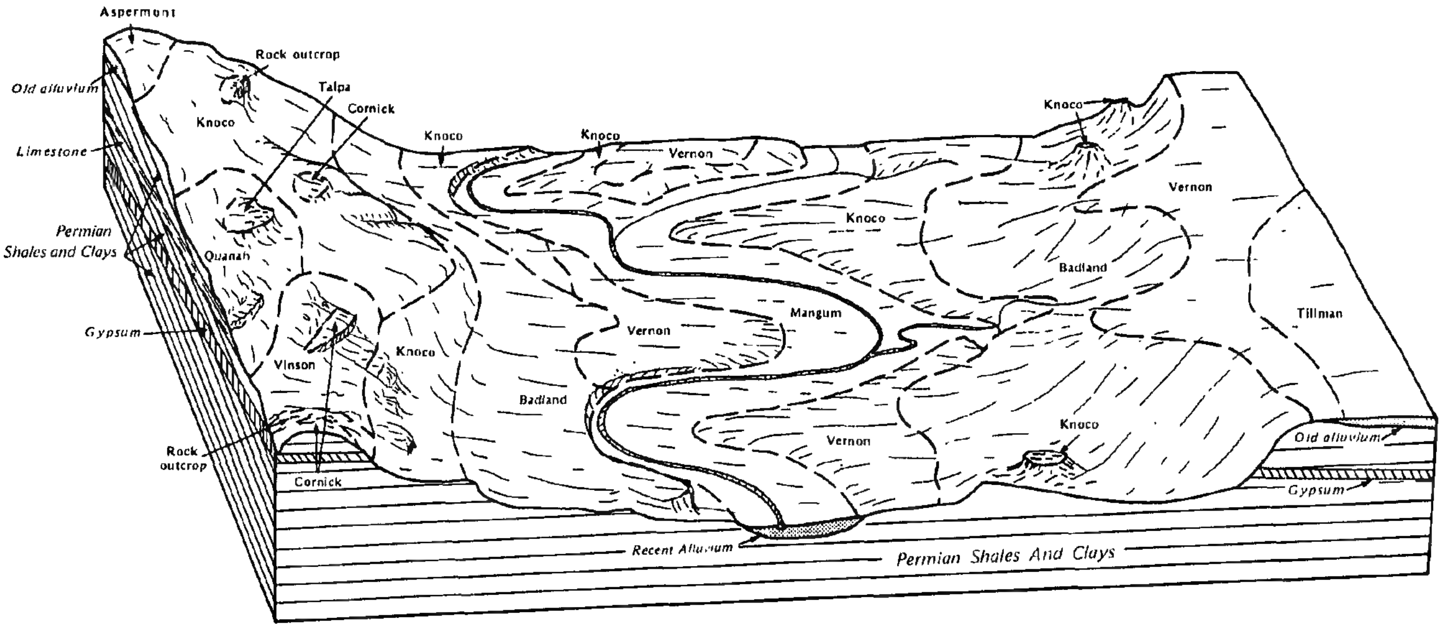


Figure 5.—Typical pattern of soils and underlying material in the Knoco-Vernon-Cornick map unit.

gently sloping to steep, and well drained to excessively drained. Typically, the Knoco soils have a surface layer of red clay. The underlying material is red clayey shale.

Vernon soils are on ridgetops and side slopes on convex uplands. These soils are moderately deep, very gently sloping to strongly sloping, and well drained. Typically, the Vernon soils have a surface layer of reddish brown clay loam. The subsoil is reddish brown and red clay. The underlying material is red, weakly consolidated shale and has thin strata of blue gray shale.

Cornick soils are on convex ridgetops and upper side slopes on uplands. These soils are very shallow, very gently sloping to gently sloping, and well drained. Typically, the Cornick soils have a surface layer of dark grayish brown silt loam. The underlying material is pinkish white and white gypsum.

Of minor extent are the well drained Aspermont, Quanah, Talpa, Tillman, and Vinson soils on the uplands, Mangum and Spur soils on flood plains of streams, and Badland and Rock outcrop in some areas.

Areas of this map unit are used mainly for native range. A few small areas are used for cultivated crops. The major management concerns are controlling brush and weeds, protecting grasses from overgrazing, and providing an adequate water supply for livestock.

These soils have very low potential for cultivated crops, tame pasture, and hay. Potential is low for range, but the soils are better suited to this use. Potential is low for most sanitary facilities and building sites, recreational uses, and wildlife habitat. Slope, depth to bedrock, shrinking and swelling, and clayey texture are the main limitations.

9. Hardeman-Tivoli-Devol

Deep, very gently sloping to moderately steep, well drained or excessively drained, loamy and sandy soils that formed in loamy and sandy eolian deposits

This map unit consists of very gently sloping to moderately steep soils on uplands that are mainly in a band south of the Salt Fork of the Red River and north of the Prairie Dog Town Fork of the Red River. Slope ranges from 1 to 20 percent.

Visual diversity in this unit is high. Landforms are very gently sloping to moderately steep. Vegetative patterns range from mixed woody species to native grasses. Water elements are farm ponds and narrow short drainageways. Manmade structures in this unit are not common.

This map unit makes up about 5.5 percent of the county. It is 55 percent Hardeman soils, 12 percent Tivoli soils, 8 percent Devol soils, and 25 percent soils of minor extent.

Hardeman soils are on convex side slopes and foot slopes on uplands. They generally are at a lower elevation than the Devol and Tivoli soils. These soils are deep, nearly level to moderately steep, and well drained.

Typically, the Hardeman soils have a surface layer of reddish brown fine sandy loam. The subsoil is reddish brown fine sandy loam. The underlying material is yellowish red fine sandy loam.

Tivoli soils are on high ridges and dunes on uplands. These soils are deep, hummocky, and excessively drained. Typically, the Tivoli soils have a surface layer of brown fine sand. The underlying material is reddish yellow fine sand.

Devol soils are on upper side slopes and narrow ridges. They generally are at a lower elevation than the Tivoli soils and at a slightly higher elevation than the Hardeman soils. These soils are deep, gently sloping to strongly sloping, and well drained. Typically, the Devol soils have a surface layer of reddish brown loamy fine sand. The subsoil is yellowish red fine sandy loam and loamy fine sand. The underlying material is yellowish red loamy fine sand.

Of minor extent are the well drained Cornick, Grandfield, Quinlan, and Woodward soils on uplands, the well drained to excessively drained Knoco soils on uplands, and the Clairemont and Yahola soils on flood plains of streams. Rock outcrop is in some areas.

Most areas of this map unit are used for native range. Some areas are used for tame pasture. The major management concerns are controlling brush and weeds, preventing soil erosion, maintaining soil structure and fertility, and controlling grazing.

These soils have medium potential for native range, for tame pasture and hay, and for cultivated crops. Potential is medium for most sanitary facilities and building sites. Potential is high for most recreational uses. The sandy surface texture of the Tivoli soils and seepage and slope are the main limitations.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series.* Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases.* Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Grandfield fine sandy loam, 0 to 2 percent slopes, is one of several phases in the Grandfield series.

Some map units are made up of two or more major soils. These map units are called soil complexes, soil associations, or undifferentiated groups.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Woodward-Quinlan complex, 1 to 3 percent slopes, is an example.

A *soil association* is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar. Knoco-Badland association, gently sloping, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas.* Such areas have little or no soil material and support little or no vegetation. Ustorthents is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

1—Abilene loam, 0 to 1 percent slopes. This deep, well drained, nearly level soil is on broad flat uplands. Slopes are smooth and convex. Areas are irregular in shape and range from 10 to 200 acres.

Typically, the surface layer is brown loam 11 inches thick. The subsoil to a depth of 38 inches is brown clay. The underlying material is light brownish gray clay loam to a depth of 72 inches and is yellowish red loam to a depth of 80 inches.

Natural fertility and organic matter content are high. The upper part of the pedon is mildly alkaline or moderately alkaline; the lower part is moderately alkaline. Permeability is moderately slow, and surface runoff is slow. The available water capacity is high. This soil has good tilth and can be worked throughout a fairly wide range of soil moisture. The root zone is deep, and plant roots penetrate it fairly easy. The shrink-swell potential is moderate.

Included with this soil in mapping are a few small areas of Altus, Grandfield, and Madge soils on convex positions. Included soils make up about 10 percent of mapped areas, but an individual area is generally less than 5 acres.

Most areas of this Abilene soil are used for cultivated crops, and the potential is high for this use. This soil is suited to wheat, alfalfa, grain sorghum, and cotton. The hazard of water erosion is slight. Contour farming and terracing help to control water erosion. Minimum tillage, winter cover crops, and residue management help to prevent soil loss, improve fertility, reduce surface crusting, and increase water infiltration.

This soil has high potential for tame pasture and hayland. It is suited to bermudagrass, weeping lovegrass, and most other grasses and legumes. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during excessively wet or dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has medium potential for rangeland, although very few areas are used for this purpose. If management is good, the production of native grasses is medium. The potential is low for trees as windbreaks. The dense clayey subsoil and the lack of rainfall in summer are the main limitations to successful establishment of trees. The potential is high for producing habitat for openland wildlife and is medium for producing habitat for rangeland wildlife.

This Abilene soil has medium potential for most building site developments and for sanitary facilities. The high shrink-swell potential is a limitation for small commercial buildings and dwellings. The slow permeability is a limitation for septic tank absorption fields. The clayey texture is the main limitation for trench type sanitary landfills and shallow excavations.

The potential is high for most recreational uses. The erodibility for paths and trails is the main limitation. In places water stands for a short period after rains. Onsite investigation is necessary to properly evaluate and plan the development of specified sites.

This soil is in capability subclass IIc, nonirrigated, and in capability class Ie, irrigated. It is in Hardland range site.

2—Abilene loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on concave slopes near the heads of drainageways on uplands. Areas are irregular in shape and range from 5 to 30 acres.

Typically, the surface layer is dark brown loam about 10 inches thick. The next layer is very dark grayish brown loam to a depth of 12 inches. The subsoil is dark grayish brown clay loam to a depth of 24 inches, light brownish gray clay loam to a depth of 45 inches, and light yellowish brown loam to a depth of 62 inches. The underlying material is light yellowish brown loam to a depth of 80 inches.

Natural fertility and organic matter content are high. The upper part of the pedon is moderately alkaline, and the lower part is moderately alkaline and calcareous. Permeability is moderately slow, and surface runoff from cultivated areas is moderate. The available water capacity is high. This soil has good tilth and can be worked throughout a fairly wide range of soil moisture. The root zone is deep, and plant roots penetrate it fairly easy.

Included with this soil in mapping are a few small areas of Altus, Grandfield, and Madge soils on small convex positions. The included soils make up about 10 percent of mapped areas, but an individual area is less than 5 acres.

Most areas of this Abilene soil are used for cultivated crops, and the potential is high for this use. This soil is suited to wheat, alfalfa, grain sorghum, and cotton. The hazard of water erosion is moderate. Minimum tillage, winter cover crops, terracing and contour farming, grassed waterways, and residue management help prevent soil loss and improve water infiltration.

This soil has high potential for tame pasture and hayland. It is suited to bermudagrass, lovegrass, alfalfa, and other adapted grasses and legumes. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during excessively wet or dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has medium potential for rangeland although very few areas are used for this purpose. If management is good, the production of native grasses is medium. The potential is low for trees as windbreaks. The dense clayey subsoil and the lack of rainfall in summer are the main limitations to successful establishment of trees. The potential is high for producing habitat for openland wildlife and is medium for producing habitat for rangeland wildlife.

This Abilene soil has medium potential for most building site developments and sanitary facilities. The high shrink-swell potential is a limitation for dwellings and small commercial buildings. The slow permeability is a limitation for septic tank absorption fields but can be overcome by increasing the size of the filter area. The clayey texture of this soil is the main limitation for trench type sanitary landfills and shallow excavations.

The potential is high for most recreational uses. The erodibility is the main limitation for paths and trails, and slope is a limitation for playgrounds. Onsite investigation is necessary to properly evaluate and plan the development of specified sites.

This soil is in capability subclass IIe. It is in Hardland range site.

3—Acme-Vinson complex, 0 to 1 percent slopes. This complex consists of shallow Acme soils and moderately deep Vinson soils on broad, flat, old stream terraces on uplands. These soils are well drained and nearly level. They formed in shallow lacustrine sediment that contained high concentrations of gypsum. Individual areas of these soils are so intermingled or so small that to separate them at the scale selected for mapping was not practical. Most areas of this complex are in the southeastern part of the county. They are irregular in shape and range from 20 to 300 acres.

The Acme soils make up about 70 percent of each mapped area. Typically, they have a surface layer of dark brown silt loam about 14 inches thick. The underlying material is soft, crystalline gypsiferous material. It is white to a depth of about 30 inches, and is pink to a depth of 80 inches.

Acme soils are medium in natural fertility and organic matter content. The Acme soils are mainly moderately alkaline and calcareous throughout, but the lower part of the underlying material is noncalcareous in some areas. Permeability is moderate, and surface runoff is slow. The available water capacity is low. Roots seldom penetrate below a depth of 10 to 15 inches because of the crystalline gypsum.

The Vinson soils make up about 25 percent of each mapped area. Typically, they have a surface layer of brown and dark brown silt loam about 17 inches thick. The subsoil is reddish brown silty clay loam to a depth of 28 inches. The underlying layer is pink, soft, crystalline gypsiferous material to a depth of about 80 inches.

Vinson soils are high in natural fertility and organic matter content. Reaction is moderately alkaline. The Vinson soils are typically calcareous throughout, but in some pedons the lower part of the underlying material is noncalcareous. Permeability is moderate, and surface runoff is slow. The available water capacity is medium. Roots seldom penetrate below a depth of 40 inches because of the crystalline gypsum.

Included with these soils in mapping are a few small areas of Abilene soils in slight depressional areas. The included soils make up about 5 percent of mapped areas, but an individual area is less than 3 acres.

Most areas of this complex are used for cultivated crops. The potential is low for this use. Areas are suited to cotton, wheat, and grain sorghum. Minimum tillage and shallow plowing are needed so that the underlying gypsum will not be mechanically mixed with the surface layer. Minimum tillage, winter cover crops, and residue management help to prevent soil loss, improve fertility, reduce surface crusting, and increase water infiltration.

Areas of this complex have low potential for tame pasture and hayland. They are suited to bermudagrass and other adapted grasses and legumes. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during excessively wet or dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This complex has low potential for rangeland, and very few areas are used for this purpose. If management is good, the production of native grasses is medium. The potential is low for trees as windbreaks. The shallow rooting depth in both soils and the low available moisture in the Acme soils are the main limitations. The potential is low for producing habitat for openland and rangeland wildlife.

Areas of this complex have high potential for most building site developments and low potential for sanitary facilities.

The potential is high for most recreational uses. Onsite investigation is necessary to properly evaluate and plan the development of specified sites.

This complex is in capability subclass IIIs, nonirrigated, and in subclass IIs, irrigated. The Acme soils are in Shallow Prairie range site, and the Vinson soils are in Loamy Prairie range site.

4—Acme-Vinson complex, 1 to 3 percent slopes. This complex consists of shallow Acme soils and moderately deep Vinson soils on broad, flat, old stream terraces on uplands. These soils are well drained and very gently sloping. They formed in shallow lacustrine sediment that contained high concentrations of gypsum. Individual areas of these soils are so intermingled or so small that to separate them at the scale selected for mapping was not practical. Most areas of this unit are in the southeastern part of the county. They are irregular in shape and range from 10 to 100 acres.

The Acme soils make up about 50 percent of each mapped area. Typically, they have a surface layer of dark brown silt loam about 13 inches thick. The underlying material is very pale brown, soft, crystalline gypsiferous material to a depth of 80 inches.

Acme soils are medium in natural fertility and organic matter content. They are mainly moderately alkaline and calcareous throughout but in some pedons the lower part is noncalcareous. Permeability is moderate, and runoff is slow. The available water capacity is low. Roots seldom penetrate below a depth of 10 to 15 inches because of the crystalline gypsiferous material.

The Vinson soils make up about 40 percent of each mapped area. Typically, they have a surface layer of dark brown silt loam about 12 inches thick. The subsoil is brown and dark brown silty clay loam to a depth of 30 inches. The underlying material is pink, soft, crystalline gypsiferous material to a depth of 80 inches.

Vinson soils are high in natural fertility and organic matter content. They are moderately alkaline and are typically calcareous throughout, but in some pedons the lower part of the underlying material is noncalcareous. Permeability is moderate, and surface runoff is slow. The

available water capacity is medium. Roots seldom penetrate below a depth of 40 inches because of the crystalline gypsiferous material.

Included with these soils in mapping are a few small areas of Abilene soils in slight depressional areas and a few small areas of outcrops of hard gypsum. The included soils and outcrops make up about 10 percent of mapped areas, but an individual area is less than 3 acres.

Most areas of this complex are used for cultivated crops. The potential is low for this use. Areas are suited to cotton, wheat, and grain sorghum. Minimum tillage and shallow plowing are needed so that the underlying gypsum will not be mechanically mixed with the surface layer. Terracing and contour farming, grassed waterways, and residue management help to prevent soil loss, improve water infiltration, and reduce surface crusting.

Areas of this complex have low potential for tame pasture and hayland. They are suited to bermudagrass and other adapted grasses and legumes. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during excessively wet or dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This complex has low potential for rangeland, and very few areas are used for this purpose. If management is good, the production of native grasses is medium. The potential is low for trees as windbreaks. The shallow rooting depth in both soils and the low available moisture in the Acme soils are the main limitations. The potential is low for producing habitat for openland and rangeland wildlife.

Areas of this complex have high potential for most building site developments and low potential for sanitary facilities.

The potential is high for most recreational uses. Onsite investigation is necessary to properly evaluate and plan the development of specified sites.

This complex is in capability subclass IIIe, irrigated and nonirrigated. The Acme soils are in Shallow Prairie range site, and the Vinson soils are in Loamy Prairie range site.

5—Altus fine sandy loam, 0 to 1 percent slopes. This deep, well drained, very gently sloping soil is in broad, smooth, convex areas and narrow concave areas on uplands. Areas are irregular in shape and range from 10 to 100 acres.

Typically, the surface layer is dark brown and dark reddish brown fine sandy loam about 12 inches thick. The subsoil is reddish brown fine sandy loam to a depth of about 21 inches, reddish brown sandy clay loam to a depth of about 45 inches, and reddish brown fine sandy loam to a depth of about 70 inches.

Natural fertility and organic matter content are high. The surface layer is slightly acid or neutral. The upper part of the subsoil is neutral or mildly alkaline, and the lower part is neutral to moderately alkaline. The lower part of the subsoil is calcareous in some areas. Permeability is moderate, and surface runoff from cultivated areas is medium. The available water capacity is medium. The surface layer is friable and easily tilled throughout a wide range of soil moisture. The root zone is deep, and roots penetrate easily through all layers of the soil.

Included with this soil in mapping are a few small areas of Grandfield soils at a higher elevation and Tipton soils at a slightly lower elevation. The included soils make up about 10 percent of mapped areas, but an individual area is generally less than 3 acres.

Most areas of this Altus soil are used for cultivated crops, and the potential is high for this use. This soil is suited to wheat, cotton, and grain sorghum. The hazard of water erosion is slight. Contour farming and terracing help to control water erosion. The hazard of wind erosion is moderate where cultivated crops are grown, and careful management is required. Wind erosion can be reduced by windbreaks and by stubble mulching. Stubble mulching, use of cover crops, and minimum tillage help to reduce runoff, control erosion, maintain tilth, and increase water infiltration.

This soil has high potential for tame pasture and hayland. It is suited to bermudagrass, weeping lovegrass, alfalfa, and other adapted grasses and legumes. The use of this soil for tame pasture or hayland effectively helps to control erosion. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

The potential is high for rangeland although very few areas are used for this purpose. If management is good, the production of native grasses is high. The potential is high for trees as windbreaks. There are no serious limitations for trees on this soil. The potential is high for producing habitat for openland wildlife and rangeland wildlife.

This Altus soil has high potential for most building site developments and has medium potential for sanitary facilities. Excessive seepage is a limitation for sewage lagoons and sanitary landfills. This can be corrected by treatment to seal the bottom of the lagoon or landfill.

The potential is high for most recreational uses. Onsite investigation is necessary to properly evaluate and plan the development of specified sites.

This soil is in capability subclass IIe, irrigated and nonirrigated. It is in Sandy Prairie range site.

6—Altus fine sandy loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is in

broad, smooth, convex areas on uplands. Areas are irregular in shape and range from 10 to 500 acres.

Typically, the surface layer is reddish brown and dark reddish gray fine sandy loam about 13 inches thick. The subsoil is reddish brown fine sandy loam, to a depth of about 21 inches, reddish brown sandy clay loam to a depth of about 38 inches, and yellowish red fine sandy loam to a depth of about 70 inches.

Natural fertility and organic matter content are high. The surface layer is slightly acid or neutral, and the subsoil is neutral or mildly alkaline. Permeability is moderate, and surface runoff from cultivated areas is medium. The available water capacity is medium. The surface layer is friable and easily tilled throughout a wide range of soil moisture. The root zone is deep, and roots penetrate easily through all layers of the soil.

Included with this soil in mapping are a few areas of Grandfield soils on the higher convex positions. The included soils make up about 10 percent of mapped areas, but an individual area is generally less than 3 acres.

Most areas of this Altus soil are used for cultivated crops, and the potential is high for this use. This soil is well suited to wheat, cotton, and grain sorghum. The hazard of water erosion is moderate. Contour farming and terracing help to control water erosion. The hazard of wind erosion is moderate where cultivated crops are grown, and careful management is required. Wind erosion can be reduced by windbreaks and by stubble mulching. Stubble mulching, use of cover crops, and minimum tillage help to reduce runoff, control erosion, maintain tilth, and increase water infiltration.

This soil has high potential for tame pasture and hayland. It is suited to bermudagrass, weeping lovegrass, alfalfa, and other adapted grasses and legumes. The use of this soil for tame pasture or hayland effectively helps to control erosion. Proper stocking rates, rotation and timely deferment of grazing, and restricted use during dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

The potential is high for rangeland although very few areas are used for this purpose. If management is good, production of native grasses is high. The potential is high for trees as windbreaks. There are no serious limitations for trees on this soil. The potential is high for producing habitat for openland wildlife and rangeland wildlife.

This Altus soil has high potential for most building site developments and has medium potential for sanitary facilities. Excessive seepage is a limitation for sewage lagoons and sanitary landfills. This can be corrected by treatment to seal the bottom of the lagoon or landfill.

The potential is medium for most recreational uses. Slope is a limiting feature for playgrounds. Onsite investigation is necessary to properly evaluate and plan the development of specified sites.

This soil is in capability subclass IIIe, irrigated and nonirrigated. It is in Sandy Prairie range site.

7—Aspermont silt loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on thinly mantled, broad convex slopes on uplands. Areas are irregular in shape and range from 10 to 150 acres.

Typically, the surface layer is reddish brown silt loam about 14 inches thick. The subsoil is yellowish red silt loam to a depth of about 29 inches and reddish brown silt loam with an accumulation of calcium carbonate to a depth of about 38 inches. The underlying material is red silt loam to a depth of 41 inches and red and gray fractured shale to a depth of 80 inches or more.

Natural fertility and organic matter content are medium. The pedon is moderately alkaline and calcareous throughout. Permeability is moderate, and surface runoff is medium. The available water capacity is high. This soil has good tilth and can be worked throughout a wide range of soil moisture.

Included with this soil in mapping are a few small areas of Quanah and Vernon soils. The included soils make up less than 10 percent of mapped areas, but an individual area is generally less than 3 acres.

Most areas of this Aspermont soil are used for cultivated crops, and the potential is medium for this use. This soil is suited to wheat, cotton, and grain sorghum. If this soil is used for cultivated crops, the hazard of erosion is moderate. Minimum tillage, winter cover crops, terracing, contour farming, windbreaks, and grassed waterways help to reduce runoff and erosion. Returning crop residue to this soil helps to maintain or improve fertility, reduces crusting, and increases water infiltration.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, and other adapted grasses and legumes. The use of this soil for tame pasture or hayland effectively helps to control erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has medium potential for rangeland. If management is good, the production of native grasses is medium. The potential is medium for trees as windbreaks. The potential is medium for producing habitat for openland and rangeland wildlife.

This Aspermont soil has high potential for most building site developments and sanitary facilities. The moderate permeability is the main limitation for septic tank absorption fields. This can be overcome by increasing the size of the absorption field.

The potential is high for most recreational uses. Slope is a moderate limitation for playgrounds. Onsite

investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIIe. It is in Hardland range site.

8—Aspermont silt loam, 3 to 5 percent slopes. This moderately deep or deep, well drained, gently sloping soil is on convex shoulder slopes on uplands. Areas are irregular in shape and range from 10 to 100 acres.

Typically, the surface layer is reddish brown silt loam about 13 inches thick. The subsoil is reddish brown silty clay loam to a depth of about 37 inches and light reddish brown silty clay loam with an accumulation of calcium carbonate to a depth of about 58 inches. The underlying material is red shale to a depth of about 80 inches.

Natural fertility and organic matter content are medium. The pedon is moderately alkaline and calcareous throughout. Permeability is moderate, and surface runoff is medium. The available water capacity is high. This soil has good tilth and can be worked throughout a wide range of soil moisture.

Included with this soil in mapping are a few small areas of Quanah and Vernon soils. The Quanah soils make up about 5 percent of mapped areas, and Vernon soils make up about 10 percent. An individual area of each soil is generally less than 5 acres.

Most areas of this Aspermont soil are used for cultivated crops. The potential for this use is medium. This soil is suited to wheat, cotton, and grain sorghum. If cultivated crops are grown, the hazard of water erosion is moderate. Minimum tillage, winter cover crops, terracing and contour farming, and grassed waterways help to reduce runoff and erosion. Returning crop residue to the soil helps to maintain organic matter, improve fertility, reduce crusting, and increase water infiltration.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, and other adapted grasses and legumes. Using this soil for tame pasture or hayland effectively helps to control erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during prolonged dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has medium potential for rangeland. If management is good, the production of native grasses is medium. The potential is medium for trees as windbreaks. Insufficient soil moisture and the depth to bedrock are the main limitations. The potential is medium for producing habitat for openland and rangeland wildlife.

This Aspermont soil has medium potential for most building site developments and sanitary facilities. The moderate permeability is a limitation for septic tank absorption fields, but this can be overcome by increasing the size of the absorption area.

The potential is high for most recreational uses. Slope is a limiting factor for playgrounds, and the hazard of erosion is a concern for paths and trails. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IVe. It is in Hardland range site.

9—Aspermont silt loam, 5 to 8 percent slopes. This moderately deep or deep, well drained, sloping soil is on convex side slopes or toe slopes on uplands. Areas are irregular in shape and range from 10 to 80 acres.

Typically, the surface layer is reddish brown silt loam about 7 inches thick. The subsoil is reddish brown silty clay loam to a depth of 22 inches and reddish brown silty clay loam with an accumulation of calcium carbonate to a depth of 35 inches. The underlying material to a depth of 60 inches is reddish brown silty clay loam.

Natural fertility and organic matter content are medium. The pedon is moderately alkaline and typically calcareous throughout. Permeability is moderate, and surface runoff is rapid. The available water capacity is medium.

Included with this soil in mapping are a few small areas of Vernon and Quanah soils. The Vernon soils make up about 10 percent of mapped areas, and the Quanah soils make up about 5 percent. An individual area of each soil is less than 3 acres.

Very few areas of this Aspermont soil are used for cultivated crops. The potential is low for this use. The severe hazard of erosion limits the suitability for cultivation. This soil is better suited to native grasses or tame pasture than to most other uses.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, and other adapted grasses and legumes. Using this soil for tame pasture and hayland effectively helps to control erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during dry periods keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

Most areas of this soil are in rangeland. The potential is medium for native grasses. If management is good, the production of native grasses is medium. The potential is medium for trees as windbreaks. Insufficient soil moisture is the main limitation. The potential is medium for producing habitat for openland and rangeland wildlife.

This Aspermont soil has medium potential for most building site developments and sanitary facilities. Medium shrink-swell is the main limitation for dwellings and small

commercial buildings. The moderate permeability is a limitation for septic tank absorption fields. Slope and seepage are limitations for sewage lagoons. The depth to rock is a limitation for trench type sanitary landfills.

The potential is high for most recreational areas. Slope is a limiting feature for playgrounds. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass VIe. It is in Hardland range site.

10—Beckman silty clay, occasionally flooded. This deep, well drained, nearly level soil is on flood plains that are subject to occasional flooding. It is slightly affected or moderately affected by saline salts. Slope is 0 to 1 percent. Areas are long and narrow along stream channels and range from 10 to 300 acres.

Typically, the surface layer is reddish brown silty clay about 11 inches thick. The underlying material is reddish brown clay to a depth of about 44 inches and reddish brown silty clay to a depth of 80 inches.

Natural fertility and organic matter content are medium. The pedon is mildly alkaline and calcareous throughout. Permeability is very slow, and surface runoff is slow. The available water capacity is medium. Root development is restricted below a depth of 20 inches because of the dense clay and excess salt content. The shrink-swell potential is high.

Included with this soil in mapping are a few small areas of Mangum and Spur soils on slightly higher elevations. The included soils make up about 10 percent of mapped areas, but an individual area is generally less than 5 acres.

Most areas of this Beckman soil are used for native grassland. The potential is high for range. If management is good, the production of native grasses is high. The proportions of desirable range plants and plant vigor can be maintained or improved by timely weed and brush control.

This soil has low potential for cultivated crops. Salt content is sufficiently high to reduce crop yield. Occasional flooding in some areas causes damage or loss of crops.

The potential is high for tame pasture and hayland. This soil is suited to bermudagrass, tall wheatgrass, and native grasses that are adapted to salty conditions. Overgrazing or grazing when the soil is too wet or dry causes surface compaction, results in poor tilth, reduces water infiltration, and causes the stand to die out. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during prolonged wet or dry periods help keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has low potential for trees as windbreaks. Windbreaks are not suited to this soil because growth is limited by droughty soil conditions, excess salt content, and the dense clayey texture which restricts root development. The potential is medium for producing habitat for openland wildlife and is low for producing habitat for rangeland wildlife.

This Beckman soil has low potential for most building site developments and sanitary facilities. Occasional flooding is a hazard for all uses. The very slow permeability is a limitation for septic tank absorption fields. The clayey texture is a limitation for trench type sanitary landfills and for shallow excavations. The high shrink-swell potential is a limitation for dwellings and small commercial buildings and for local roads and streets.

The potential is low for most recreational uses. Excess salt is a limitation for playgrounds, picnic areas, and camp areas. Flooding is a hazard for camp areas. The clayey texture is a limitation for golf fairways. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IVs. It is in Heavy Bottomland (moderately alkaline) range site.

11—Carey loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on convex uplands. Areas are irregular in shape and range from 5 to 100 acres.

Typically, the surface layer is reddish brown loam about 15 inches thick. The subsoil is reddish brown clay loam to a depth of about 42 inches and reddish yellow loam to a depth of about 65 inches. The underlying material is red, weakly consolidated sandstone to a depth of 80 inches or more.

Natural fertility and organic matter content are high. The surface layer is neutral or mildly alkaline, the upper part of the subsoil is neutral to moderately alkaline, and the lower part of the subsoil is moderately alkaline. Permeability is moderate, and surface runoff from cultivated areas is medium. The available water capacity is high. The surface layer is friable and easily tilled throughout a fairly wide range of soil moisture. The soil surface tends to crust or puddle after hard rains. The root zone is deep, and root development is not restricted to a depth of 40 inches or more.

Included with this soil in mapping are a few small areas of Madge soils generally on upper slopes and Woodward soils on small knobs. The included soils make up about 10 percent of mapped areas, but an individual area is less than 3 acres.

Most areas of this Carey soil are used for cultivated crops. The potential is high for this use. This soil is suited to wheat, cotton, alfalfa, and grain sorghum. If this soil is used for cultivated crops, the hazards of wind and water erosion are moderate. Minimum tillage, terracing and contour farming, grassed waterways, windbreaks, and winter cover crops help to reduce erosion. Returning crop residue to the soil or the regular addition of other organic material helps to improve fertility, maintain

organic matter, reduce crusting, and increase water infiltration.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, alfalfa, and other adapted grasses and legumes. Use of this soil for hayland and pasture effectively helps to control erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during prolonged wet and dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has medium potential for rangeland. However, only a few areas are used for this purpose. If management is good, production of native grasses is high. The potential is high for trees as windbreaks. The potential is high for producing habitat for openland wildlife and is medium for producing habitat for rangeland wildlife.

This Carey soil has high potential for most building site developments and medium potential for sanitary facilities. Slope and seepage are limitations for sewage lagoons, but they can be overcome by proper design and by special treatment to seal the bottom of the lagoon.

The potential is medium for most recreational uses. Slope is the main limitation for playgrounds, and erosion is a hazard for paths and trails. Onsite investigation is necessary to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIe. It is in Loamy Prairie range site.

12—Clairemont silt loam, occasionally flooded. This deep, well drained, nearly level soil is on flood plains that are subject to occasional flooding. Slope is 0 to 1 percent. Areas are irregular in shape and range from 5 to 250 acres.

Typically, the surface layer is reddish brown, calcareous silt loam about 7 inches thick. The underlying material is reddish brown, calcareous silt loam and loam to a depth of about 80 inches. In the lower part, it has thin strata of very fine sandy loam and silt loam.

Natural fertility is high, and organic matter content is medium. The pedon is moderately alkaline throughout. Permeability is moderate, and surface runoff in cultivated areas is slow. The available water capacity is high. The surface layer is friable and easily tilled throughout a fairly wide range of soil moisture. The soil surface tends to crust or puddle after hard rains. The root zone is deep, and root development generally is not restricted.

Included with this soil in mapping are small areas of Yahola soils on or near stream levees and a few areas of Spur soils on the slightly higher positions. The included soils make up about 5 percent of mapped areas, but an individual area is less than 3 acres.

Most areas of this Clairemont soil are used for cultivated crops. The potential is high for this use. This soil is suited to wheat, grain sorghum, alfalfa, and cotton. The hazard of water erosion is slight. Minimum tillage, winter cover crops, and return of crop residue to the soil help to improve fertility, reduce crusting, and increase water infiltration.

This soil has high potential for tame pasture and hayland. It is suited to bermudagrass, weeping lovegrass, alfalfa, and other adapted grasses and legumes. Overgrazing or grazing when the soil is too wet causes surface compaction, results in poor tilth, and reduces water infiltration. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during wet periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

The potential is high for rangeland, although very few areas of this soil are used for this purpose. If management is good, production of native grasses is high. The potential is high for use of trees as windbreaks. Occasional flooding is a hazard to establishing trees. The high available water capacity helps to promote good growth. The potential is high for producing habitat for openland wildlife and is medium for producing habitat for rangeland wildlife.

This Clairemont soil has low potential for most building site developments and sanitary facilities. Flooding is the main hazard.

The potential is medium for most recreational uses. Flooding is the main hazard for camp areas and playgrounds. Onsite investigation is necessary to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIw. It is in Loamy Bottomland range site.

13—Cornick-Vinson-Rock outcrop complex, 1 to 5 percent slopes. This complex consists of very shallow, well drained, very gently sloping and gently sloping Cornick soils on convex ridgetops and side slopes and moderately deep, well drained, very gently sloping and gently sloping Vinson soils on convex side slopes and foot slopes. Areas of Rock outcrop are scattered throughout the unit. Individual areas of these soils and Rock outcrop are so intermingled or so small that to separate them at the scale selected for mapping was not practical. Areas are irregular in shape and range from 10 to 2,000 acres.

The Cornick soils make up about 40 percent of each mapped area. Typically, they have a surface layer of dark grayish brown silt loam about 5 inches thick. The underlying material is pinkish white, weathered gypsum to a depth of about 10 inches and is white gypsum to a depth of 15 inches.

Cornick soils are high in natural fertility and organic matter content. The pedon is moderately alkaline and calcareous throughout. Permeability is moderate, and surface runoff is medium. The available water capacity is very low. The root zone is very shallow, and root penetration is restricted because of the gypsum.

The Vinson soils make up about 22 percent of each mapped area. Typically, they have a surface layer of brown silt loam about 18 inches thick. The subsoil is brown silty clay loam to a depth of about 25 inches. The underlying material is white gypsite to a depth of about 30 inches or more.

Vinson soils are high in natural fertility and organic matter content. The pedon is moderately alkaline and calcareous throughout. Permeability is moderate, and surface runoff is medium. The available water capacity is medium. The root zone is moderately deep, and root penetration is restricted because of the gypsum.

Rock outcrop makes up about 15 percent of each mapped area and consists of exposed, soft, gypsum bedrock. The areas of Rock outcrop are 1/5 acre to 5 acres and are almost bare of vegetation. Surface runoff is very rapid.

Included with this complex in mapping are a few small areas of Vernon soils on side slopes, Talpa soils mainly on convex side slopes, and Aspermont soils. The included soils make up about 23 percent of mapped areas, but an individual area generally is less than 5 acres.

Most areas of this complex are used for rangeland. The potential is low to medium, but the soils are better suited to rangeland than to most other uses. Depth to bedrock and very low to medium available water capacity are the main limiting features. If management is good, production of native grass on the Cornick soils is low and on the Vinson soils is medium.

The potential is low for cultivated crops, tame pasture, and hayland. Depth to bedrock, outcrops of rock, and very low to medium available water capacity are the main limiting features and are difficult to overcome.

This complex has low potential for trees as windbreaks. Depth to bedrock and very low to medium available water capacity are the main limiting features. The potential is medium for producing habitat for openland wildlife and low for producing habitat for rangeland wildlife.

This complex has low to medium potential for most building site developments and low potential for sanitary facilities. Shallow depth to bedrock is the main limiting feature for nearly all uses. Where possible, the moderately deep Vinson soils should be selected for sanitary use.

The potential is medium for most recreational uses. Shallow depth to bedrock is the main limitation. Where possible, the moderately deep Vinson soils should be selected for recreational use. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This complex is in capability subclass VIIs. The Cornick soils are in Gyp range site, the Vinson soils are in Loamy Prairie range site, and the Rock outcrop is not assigned to a range site.

14—Devol loamy fine sand, 0 to 3 percent slopes. This deep, well drained, nearly level and very gently sloping soil is on convex ridgetops and broad side slopes on uplands. Areas are irregular in shape and range from 10 to 1,500 acres.

Typically, the surface layer is reddish brown loamy fine sand about 12 inches thick. The subsoil is yellowish red fine sandy loam to a depth of 35 inches and is yellowish red loamy fine sand to a depth of about 44 inches. The underlying material is yellowish red loamy fine sand to a depth of 80 inches.

Natural fertility is medium, and organic matter content is low. The surface layer is slightly acid or neutral, and the subsoil is neutral to moderately alkaline. Permeability is moderately rapid, and runoff is very slow. The available water capacity is medium. The surface layer is friable and easily tilled throughout a wide range of soil moisture. Root development is not restricted, and roots penetrate all layers of the soil.

Included with this soil in mapping are a few areas of Grandfield and Grandmore soils on concave positions. The included soils make up about 10 percent of mapped areas, but an individual area is less than 5 acres.

Most areas of this Devol soil are used for cultivated crops. The potential is medium for this use. This soil is suited to wheat, cotton, alfalfa, and grain sorghum. Where this soil is used for cultivated crops, the hazard of wind erosion is severe and very intensive conservation treatments are required. Minimum tillage, residue management, windbreaks, and winter cover crops help to reduce wind erosion. The hazard of water erosion is slight. This soil is generally too sandy for terraces, but the use of crop residue helps to slow runoff.

This Devol soil has medium potential for tame pasture and hayland. It is suited to alfalfa, bermudagrass, weeping lovegrass, and other adapted grasses and legumes for hay and pasture. The use of this soil as tame pasture or hayland effectively helps to control erosion. Overgrazing during dry periods causes the grass stand to die out and increases the hazard of soil blowing. Proper stocking rates, restricted use during prolonged dry periods, and timely deferment and rotation of grazing help to keep the grasses and the soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

The potential is medium for rangeland. If management is good, production of native grasses is medium. The potential is high for trees as windbreaks. Soil erosion is a

hazard in establishing plants. The potential is medium for producing habitat for openland and rangeland wildlife.

This Devol soil has high potential for most building site developments and medium potential for most sanitary facilities. Seepage is a concern for sewage lagoons and sanitary landfills. Excessive seepage from sewage lagoons can be prevented by special treatment to seal the bottom of the lagoon. The sandy texture is a severe limitation for shallow excavations.

The potential is high for most recreational uses. Slope is the main limitation for playgrounds but can be partly overcome by maintaining a good grass cover. Onsite investigation is essential when planning the development of specified sites for all uses.

This soil is in capability subclass IIIe, irrigated and nonirrigated. It is in Deep Sand range site.

15—Devol loamy fine sand, 3 to 8 percent slopes. This deep, well drained, gently sloping to sloping soil is on convex ridgetops and side slopes in hummocky areas on uplands. Areas are irregular in shape and range from 10 to 250 acres.

Typically, the surface layer is brown loamy fine sand about 15 inches thick. The subsoil is yellowish red fine sandy loam to a depth of about 26 inches, reddish yellow fine sandy loam to a depth of about 48 inches, and reddish yellow loamy fine sand to a depth of about 62 inches. The underlying material is reddish yellow loamy sand to a depth of 80 inches or more.

Natural fertility and organic matter content are low. The surface layer is neutral or mildly alkaline, and the subsoil is neutral to moderately alkaline. Permeability is moderately rapid, and surface runoff is slow. The available water capacity is medium. The surface layer is friable and can be worked throughout a wide range of soil moisture. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are a few small areas of Grandfield soils on flat ridges or in concave positions. The included soils make up about 10 percent of mapped areas, but an individual area is less than 3 acres.

Most areas of this Devol soil are used for cultivated crops. The potential is medium for this use. This soil is suited to wheat, cotton, and grain sorghum. When this soil is used for cultivated crops, the hazard of wind erosion is severe, and intensive conservation treatments are required. Windbreaks, minimum tillage, residue management, and winter cover crops help to reduce soil erosion. The hazard of water erosion is moderate, but this soil is too sandy for terraces. Leaving crop residue on the surface helps to reduce runoff.

The potential is medium for tame pasture and hayland. This soil is suited to alfalfa, bermudagrass, weeping lovegrass, and other adapted grasses and legumes. The use of this soil for tame pasture or hayland effectively helps to control erosion. Overgrazing during dry periods causes the grass stand to die out and increases the hazard of wind erosion. Proper stocking rates, restricted use during prolonged dry periods, and timely deferment and rotation of grazing help to keep the grasses and the soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has medium potential for rangeland. If management is good, production of native grasses is medium. The potential is high for trees as windbreaks. Wind erosion and insufficient soil moisture during summer are problems in the establishment of young trees. The potential is medium for producing habitat for openland and rangeland wildlife.

This Devol soil has high potential for most building site developments and has medium potential for most sanitary facilities. Seepage is the main limitation for sewage lagoons and sanitary landfills. The sandy texture is the main limitation for shallow excavations.

The potential is high for most recreational uses. The slope is the main limitation for playgrounds. Onsite investigation is essential to properly evaluate and plan development of specified sites for all uses.

This soil is in capability subclass IVe. It is in Deep Sand range site.

16—Devol loamy fine sand, 3 to 8 percent slopes, eroded. This deep, well drained, gently sloping to sloping soil is on convex side slopes in hummocky areas on uplands. Most all areas are in old abandoned cropland. As much as 50 percent of the original surface layer has been removed by water erosion, rills and small crossable gullies are common, and a few noncrossable gullies are in some areas. Areas are irregular in shape and range from 10 to 80 acres.

Typically, the surface layer is reddish brown loamy fine sand about 6 inches thick. The subsoil is light reddish brown fine sandy loam to a depth of 15 inches, reddish yellow fine sandy loam to a depth of 25 inches, and reddish yellow loamy fine sand to a depth of 42 inches. The underlying material is reddish yellow loamy fine sand to a depth of 80 inches.

Natural fertility and organic matter content are low. The surface layer is neutral or mildly alkaline, and the subsoil is neutral to moderately alkaline. Permeability is moderately rapid, and surface runoff is rapid. The available water capacity is medium. The root zone is deep and is easily penetrated by plant roots.

Included with this soil in mapping are a few small areas of Grandfield soils on narrow ridgetops. The included soils make up about 5 percent of mapped areas, but an individual area is less than 3 acres.

This soil has low potential for cultivated crops. It is poorly suited to cotton, wheat, and grain sorghum. The hazards of wind and water erosion are severe, and intensive conservation treatments are required. Minimum tillage, windbreaks, residue management, winter cover

crops, and grassed waterways help to reduce erosion losses.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, and other adapted grasses and legumes. The use of this soil for tame pasture or hayland is effective in helping to control erosion. Overgrazing or grazing during dry periods causes surface compaction, excessive runoff, and poor tilth and increases the hazard of wind erosion. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

The potential for rangeland is medium. If management is good, production of native grasses is medium. The potential is high for trees as windbreaks. Wind erosion is a hazard, and low available water capacity is a limitation. The potential is medium for producing habitat for openland and rangeland wildlife.

This Devol soil has medium potential for most building site developments and sanitary facilities. Seepage is the main limitation for trench type and area type sanitary landfills and for sewage lagoons. The sandy texture is the main limitation for shallow excavations.

The potential is high for most recreational uses. The slope is the main limitation for playgrounds. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IVe. It is in Deep Sand range site.

17—Devol fine sandy loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on broad convex ridgetops and side slopes on uplands. Areas are irregular in shape and range from 15 to 80 acres.

Typically, the surface layer is reddish brown fine sandy loam about 9 inches thick. The subsoil is red fine sandy loam to a depth of 44 inches. The underlying material is light red loamy fine sand to a depth of 80 inches or more.

Natural fertility and organic matter content are low. The surface layer is neutral or mildly alkaline, and the subsoil is neutral to moderately alkaline. Permeability is moderately rapid, and surface runoff is slow. The available water capacity is medium. The surface layer is friable and can be worked throughout a wide range of soil moisture. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are a few small areas of Grandfield soil. The included soils make up about 10 percent of mapped areas, but an individual area is generally less than 5 acres.

Most areas of this Devol soil are used for cultivated crops, and the potential is medium for this use. This soil is suited to cotton, wheat, and grain sorghum. The hazard of water erosion is slight. Contour farming and terracing help to control water erosion. The hazard of wind erosion is moderate where cultivated crops are grown, and careful management is required. Stubble mulching, use of cover crops, windbreaks, and minimum tillage help to reduce runoff, control erosion, maintain tilth, and increase water infiltration.

This soil has high potential for tame pasture and hayland. It is suited to alfalfa, bermudagrass, lovegrass, and other adapted grasses and legumes. The use of this soil for tame pasture or hayland is effective in helping to control erosion. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

The potential is high for rangeland, although very few areas are used for this purpose. If management is good, production of native grasses is high. The potential is high for trees as windbreaks. The potential is high for producing habitat for openland wildlife and medium for producing habitat for rangeland wildlife.

This Devol soil has high potential for most building site developments and has medium potential for most sanitary facilities. Seepage is the main limitation for sewage lagoons and sanitary landfills. Excessive seepage from sewage lagoons can be prevented by special treatment to seal the bottom of the lagoon. The sandy texture is a limitation for shallow excavations.

The potential is high for most recreational uses. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIIe, irrigated and nonirrigated. It is in Sandy Prairie range site.

18—Gracemont fine sandy loam, saline, frequently flooded. This deep, somewhat poorly drained, nearly level soil is on concave positions or in slight depressional areas on flood plains along the Salt Fork of the Red River, Turkey Creek, or their tributaries. The flood plains are frequently flooded for very brief durations. The stream channels are choked with sediment, or the stream drainage is restricted by some other means that allows the water table to rise to a depth of 6 to 40 inches during most of the year. This soil is slightly or moderately affected by saline salts. Slope is 0 to 1 percent. Areas are irregular in shape and range from 5 to 100 acres.

Typically, the surface layer is brown fine sandy loam about 14 inches thick. The underlying material is brown fine sandy loam to a depth of 80 inches. It has thin strata of loamy fine sand, silt loam, and loam.

Natural fertility and organic matter content are medium. The pedon is moderately alkaline and calcareous throughout. Permeability is moderate to moderately rapid, and surface runoff is very slow. The

available water capacity is medium. In some areas during wet seasons, water ponds on the surface for prolonged periods. Root development is somewhat restricted below a depth of 30 inches by the high water table and by salts in the soil.

Included with this soil in mapping are a few small areas of Lincoln, Gracemore, and Yahola soils. Also included are small areas of Gracemont soils that are not saline. The included soils make up about 10 percent of mapped areas, but an individual area generally is less than 3 acres.

This soil has medium potential for tame pasture and hayland. It is suited to bermudagrass, tall wheatgrass, and adapted grasses and legumes that are salt tolerant. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during wet periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

Very few areas of this soil are used for cultivated crops. The potential is low for this use. Frequent flooding is a hazard. The high water table and the salt content limit growth of most field crops. If this soil is used for cultivated crops, flood control and subsurface drainage are needed to lower the water table and provide good rooting depth for the crop.

The potential is high for rangeland. If management is good, production of native grasses is high. The potential is low for trees as windbreaks. Windbreaks generally are not suitable. The potential is low for producing habitat for openland and rangeland wildlife.

This Gracemont soil has low potential for most building site developments and sanitary facilities. The high water table and the frequent flooding are major concerns for dwellings, small commercial buildings, roads and streets, sewage lagoons, sanitary landfills, septic tank absorption fields, and shallow excavations.

The potential is low for most recreational uses. The high water table and the frequent flooding are the main limitations. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass Vs. It is in Subirrigated (saline) range site.

19—Gracemore loam, saline, frequently flooded. This deep, somewhat poorly drained, nearly level soil is on flood plains mainly in old abandoned stream channels along the Prairie Dog Town Fork of the Red River and the mouth of Buck Creek. The flood plains are subject to frequent flooding. This soil is slightly or moderately affected by saline salts. A water table fluctuates from near the surface to a depth of about 40 inches. It is nearest the surface during winter and spring. Slope is 0 to 1 percent. Areas are irregular in shape and range from 5 to 50 acres.

Typically, the surface layer is light reddish brown loam about 12 inches thick. The underlying material is light brown loamy fine sand to a depth of 80 inches. It contains thin strata of fine sandy loam.

Natural fertility and organic matter content are low. The pedon is moderately alkaline and calcareous throughout. Permeability is moderately rapid, and surface runoff is slow. The available water capacity is low. In some areas during wet seasons, water ponds on the surface for short periods. Root development is restricted below a depth of 30 inches by the high water table.

Included with this soil in mapping are a few small areas of Gracemont, Lincoln, and Yahola soils. The included soils make up about 15 percent of mapped areas, but an individual area is generally less than 3 acres.

This soil has medium potential for tame pasture and hayland. It is suited to tall wheatgrass, bermudagrass, and adapted grasses and legumes that are salt tolerant. Tall fescue is suited to the low lying areas, but some summer kill may occur. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during wet periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has low potential for cultivated crops. Frequent flooding is a hazard. The high water table and the salt content limit growth of most cultivated crops.

The potential is high for rangeland. If management is good, production of native grasses on this soil is high. The potential is low for trees as windbreaks. Windbreaks generally are not suitable. The potential is low for producing habitat for openland wildlife and rangeland wildlife and medium for producing habitat for wetland wildlife.

This Gracemore soil has low potential for most building site developments and sanitary facilities. The high water table and the frequent flooding are the main concerns for dwellings, small commercial buildings, roads and streets, sewage lagoons, sanitary landfills, septic tank absorption fields, and shallow excavations.

The potential is low for most recreational uses. Flooding and the high water table are the main limiting features. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass Vs. It is in Subirrigated (saline) range site.

20—Grandfield loamy fine sand, 0 to 3 percent slopes. This deep, well drained, nearly level and very gently sloping soil is on broad ridgetops on uplands.

Areas are irregular in shape and range from 10 to 200 acres.

Typically, the surface layer is light brown and brown loamy fine sand about 15 inches thick. The subsoil is reddish brown fine sandy loam to a depth of about 38 inches, reddish brown and yellowish red sandy clay loam to a depth of about 68 inches, and yellowish red fine sandy loam to a depth of about 80 inches.

Natural fertility is medium, and organic matter content is low. The surface layer is slightly acid to mildly alkaline, and the subsoil is neutral to moderately alkaline. Permeability is moderate, and surface runoff is slow. The available water capacity is medium. The surface layer is loose and is easily tilled throughout a wide range of soil moisture. Root development is not restricted, and roots penetrate all layers of the soil.

Included with this soil in mapping are small areas of Devol soils on ridges and knobs. The included soils make up about 8 percent of mapped areas, but an individual area generally is less than 5 acres.

Most areas of this Grandfield soil are used for cultivated crops and the potential is medium for this use. This soil is suited to wheat, cotton, and grain sorghum. Where cultivated crops are grown, the hazard of wind erosion is severe, and very intensive conservation measures are required. Minimum tillage, residue management, cover crops, contour farming, windbreaks and grassed waterways help to prevent wind erosion.

The potential is medium for tame pasture and hayland. This soil is suited to alfalfa, bermudagrass, weeping lovegrass, and other adapted grasses and legumes. The use of the soil for tame pasture or hayland is effective in helping to control erosion. Overgrazing during dry periods causes the stand to die out. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has medium potential for rangeland. If management is good, production of native grasses is medium. The potential is high for trees as windbreaks, and there are no serious limitations to growing trees on this soil. The potential is medium for producing habitat for openland wildlife and high for producing habitat for rangeland wildlife.

This Grandfield soil has high potential for most building site developments and has medium potential for sanitary facilities. Excessive seepage from sewage lagoons is a concern, but this can be overcome by treatments to seal the bottom of the lagoon. Seepage is the main limitation for trench sanitary landfills. The moderate permeability is the main limitation for septic tank absorption fields.

The potential is high for most recreational uses. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIIe, irrigated and nonirrigated. It is in Deep Sand range site.

21—Grandfield loamy fine sand, 2 to 5 percent slopes, eroded. This deep, well drained, gently sloping and very gently sloping soil is on convex eroded uplands. In many areas, the subsoil is exposed in the plow layer. Small crossable gullies are common. Areas are irregular in shape and range from 10 to 150 acres.

Typically, the surface layer is brown loamy fine sand about 11 inches thick. The subsoil is yellowish red sandy clay loam to a depth of about 20 inches and reddish yellow fine sandy loam to a depth of about 44 inches. The underlying material is reddish yellow loamy fine sand to a depth of 80 inches.

Natural fertility is medium, and organic matter content is low. The upper part of the subsoil ranges from slightly acid to mildly alkaline, and the lower part ranges from neutral to moderately alkaline. Permeability is moderate, and surface runoff from cultivated areas is high. The available water capacity is medium. The surface layer is loose and easily tilled throughout a fairly wide range of soil moisture. In areas where the plow layer contains subsoil material, it tends to crust or puddle after hard rains. These areas generally have poor surface structure. Root development in this soil is not restricted to a depth of 60 inches or more.

Included with this soil in mapping are a few small areas of Devol soils on ridges or knobs. The included soils make up about 5 percent of the mapped areas, but an individual area is less than 5 acres.

Most areas of this soil have been used for cultivated crops, but about 50 percent of the previously cultivated areas are now seeded to grass. The potential is low for cultivated crops. This soil is fairly suited to cotton, wheat, and grain sorghum, and these crops can be grown if management is intensive. The hazards of wind and water erosion are very severe in cultivated cropland. Minimum tillage, cover crops, terracing, and contour farming, grassed waterways, windbreaks and residue management help to reduce additional loss of soil and conserve soil moisture.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, and other adapted plants. The use of this soil for tame pasture or hayland is effective in helping to control erosion. Overgrazing, especially during dry periods, causes the stand of grass to die out. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during dry periods help keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has medium potential for rangeland. If management is good, production of native grasses is medium. The potential is high for trees as windbreaks. Slope and erosion are the main concerns. The potential

is medium for producing habitat for openland wildlife and is high for producing habitat for rangeland wildlife.

This Grandfield soil has high potential for most building site developments and has medium potential for sanitary facilities. Moderate permeability is the main limitation for septic tank absorption fields, but it can be overcome by increasing the size of the absorption field. Excessive seepage is the main limitation for sewage lagoons, but seepage can be corrected by special treatments to seal the bottom of the lagoon. Seepage is the main limitation for trench type sanitary landfills.

The potential is high for most recreational uses. Slope is the main limitation for playgrounds. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IVe. It is in Deep Sand range site.

22—Grandfield fine sandy loam, 0 to 2 percent slopes. This deep, well drained, nearly level and very gently sloping soil is on broad rolling uplands and ridgetops. Areas are irregular in shape and range from 5 to 300 acres.

Typically, the surface layer is reddish brown fine sandy loam about 9 inches thick. The subsoil is yellowish red fine sandy loam to a depth of about 14 inches, yellowish red sandy clay loam to a depth of about 38 inches, and reddish yellow fine sandy loam to a depth of about 55 inches. The underlying material is light brown fine sandy loam to a depth of 80 inches.

Natural fertility and organic matter content are medium. The surface layer is slightly acid or neutral, and the subsoil ranges from neutral to moderately alkaline. Permeability is moderate, and surface runoff is medium. The available water capacity is medium. The surface layer is friable and easily tilled throughout a wide range of soil moisture. Root development is not restricted, and roots penetrate the soil throughout.

Included with this soil in mapping are small areas of Devol and Altus soils. The included soils make up about 10 percent of mapped areas, but an individual area is less than 5 acres.

Most areas of this Grandfield soil are used for cultivated crops, and the potential is medium for this use. This soil is suited to wheat, grain sorghum, cotton, and alfalfa (fig. 6). The hazards of wind and water erosion are moderate, and cultivated crops require careful management. Terracing, contour farming, cover crops, and residue management help to prevent erosion and conserve moisture. Windbreaks, cover crops, and crop residue left on the surface help to prevent soil blowing.

The potential is high for tame pasture and hayland. This soil is well suited to alfalfa, bermudagrass, and weeping lovegrass. Use of this soil for tame pasture or hayland is effective in helping to control erosion. Overgrazing during dry periods causes the grass stand to die out. Proper stocking rates, timely deferment and

Figure 6.—Dryland wheat in an area of Grandfield fine sandy loam, 0 to 2 percent slopes.

rotation of grazing, and restricted use during dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has high potential for rangeland. If management is good, production of native grasses is high. Care must be taken, however, to control stocking rates and time of grazing since the grass stand is easily damaged during periods of drought. The potential is high for trees as windbreaks. Trees make good growth and are long lived because of the deep, permeable subsoil. The potential is high for producing habitat for openland and rangeland wildlife.

This Grandfield soil has high potential for most building site developments and has medium potential for sanitary facilities. Seepage from sewage lagoons and trench type sanitary landfills can be overcome by treatments to seal the bottom of excavations. The

moderate permeability is a limitation for septic tank absorption fields.

The potential is high for most recreational uses. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIIe, irrigated and nonirrigated. It is in Sandy Prairie range site.

23—Grandfield fine sandy loam, 2 to 5 percent slopes, eroded. This deep, well drained, very gently sloping and gently sloping soil is on broad, rolling eroded uplands. In many areas, the subsoil is exposed in the plow layer. Small gullies that can be crossed with farm machinery are common. Individual areas are irregular in shape and range from 5 to 75 acres.

Typically, the surface layer is reddish brown fine sandy loam about 7 inches thick. The subsoil is reddish brown fine sandy loam to a depth of about 14 inches, reddish brown and yellowish red sandy clay loam to a depth of about 41 inches, and yellowish red fine sandy loam to a depth of about 50 inches. The underlying material is yellowish red loamy fine sand to a depth of about 80 inches.

Natural fertility and organic matter content are medium. The surface layer is slightly acid to neutral, and the lower part of the subsoil ranges from neutral to moderately alkaline. The surface layer is friable and easily tilled throughout a fairly wide range of soil moisture. Permeability is moderate, and surface runoff is medium. The available water capacity is medium. Root development is not restricted, and roots penetrate the soil throughout.

Included with this soil in mapping are a few small areas of McKnight soils that have Permian redbed material at a depth of about 40 inches and a few small areas of Altus soils. The included soils make up about 10 percent of mapped areas, but an individual area is less than 5 acres.

Most areas of this Grandfield soil are used for cultivated crops, and potential is medium for this use. This soil is suited to wheat, cotton, and grain sorghum. If this soil is used for cultivated crops, the hazards of wind and water erosion are severe and intensive conservation measures are required. Minimum tillage, cover crops, residue management, terracing, contour farming, and grassed waterways help to prevent excessive erosion. Residue management helps to maintain good tilth and increase the water infiltration rate. Windbreaks, cover crops, and crop residue left on the surface help to reduce soil erosion.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass and weeping lovegrass. The use of this soil for tame pasture or hay is effective in helping to control erosion. Overgrazing during prolonged dry periods causes the grass stand to die out and increases the hazard of erosion. Proper stocking rates and timely deferment and rotation of grazing help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has high potential for rangeland. If management is good, the production of native grasses is high. The potential is high for trees as windbreaks. This soil does not have serious limitations for trees. The potential is medium for producing habitat for openland wildlife. It is high for producing habitat for rangeland wildlife.

This Grandfield soil has high potential for most building site developments and has medium potential for sanitary facilities. Seepage is the main limitation for sewage lagoons and trench type sanitary landfills. The moderate permeability is a limitation for septic tank absorption fields.

The potential is high for most recreational uses. Slope is a limiting factor for the development of playgrounds. Onsite investigation is essential to properly evaluate and plan development of specified sites for all uses.

This soil is in capability subclass IVe. It is in Sandy Prairie range site.

24—Grandmore loamy fine sand, 0 to 3 percent slopes. This deep, moderately well drained, nearly level and very gently sloping soil is on broad, smooth to slightly concave uplands. Areas are long and narrow and range from 10 to 320 acres.

Typically, the surface layer is brown loamy fine sand about 18 inches thick. The subsoil is reddish gray sandy clay loam to a depth of about 31 inches, and grayish brown and light gray mottled clay loam to a depth of about 80 inches.

Natural fertility is medium, and organic matter content is low. The surface layer and upper part of the subsoil are neutral to moderately alkaline, and the lower part of the subsoil is mildly alkaline or moderately alkaline. Permeability is moderately slow, and surface runoff is slow. The available water capacity is medium. The surface layer is friable and easily tilled throughout a wide range of soil moisture. Root development is somewhat restricted below a depth of 30 inches by buried, clayey layers.

Included with this soil in mapping are a few small areas of Devol, Grandfield, and Abilene soils. The Devol soils are on side slopes and narrow ridgetops. The Grandfield and Abilene soils are on adjacent smooth to slightly concave slopes. The included soils make up about 15 percent of mapped areas, but an individual area is less than 5 acres.

Most areas of this Grandmore soil are used for cultivated crops, and the potential is medium for this use. The main concerns are droughtiness, wind erosion, and slope. This soil is suited to wheat, cotton, and grain sorghum. Where this soil is used for cultivated crops, the hazards of wind and water erosion are severe, and careful management is required. Minimum tillage,

terracing, contour farming, grassed waterways, winter cover crops, field windbreaks, and residue management help to prevent erosion, improve fertility, reduce surface crusting, and increase water infiltration.

The potential is medium for tame pasture and hayland. This soil is suited to alfalfa, bermudagrass, weeping lovegrass, and other adapted grasses and legumes. Droughtiness and wind erosion are the main concerns. Overgrazing during dry periods causes the grass stand to die out. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has medium potential for rangeland. If management is good, the production of native grasses is medium. The potential is high for trees as windbreaks. Trees make good growth, but roots may be somewhat restricted by buried, clayey horizons below a depth of 30 inches.

This Grandmore soil has medium potential for most building site developments and sanitary facilities. The moderately slow permeability is a limitation for septic tank absorption fields. Slope is a limitation for sewage lagoons. The clayey texture of the subsoil is a limitation for trench type sanitary landfills and shallow excavations. The shrink-swell potential is a limitation for dwellings with basements and without basements.

The potential is high for most recreational uses. Slope is a limitation for playgrounds. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIIe. It is in Deep Sand range site.

25—Hardeman fine sandy loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on convex side slopes of upland terraces. Most areas of this soil are parallel to the Salt Fork and Prairie Dog Town Fork of the Red River. Areas are irregular in shape and range from 20 to 80 acres.

Typically, the surface layer is reddish brown fine sandy loam about 9 inches thick. The subsoil is reddish brown fine sandy loam to a depth of about 46 inches. The underlying material is yellowish red fine sandy loam to a depth of 80 inches.

Natural fertility and organic matter content are medium. The surface layer is mildly alkaline or moderately alkaline. The subsoil is moderately alkaline and becomes calcareous at a depth of about 27 inches. Permeability is moderately rapid, and surface runoff is slow. The available water capacity is medium. The surface layer is friable and easily tilled throughout a wide range of soil moisture. Root development is not restricted.

Included with this soil in mapping are small areas of Woodward and Aspermont soils on higher parts of the landscape. The included soils make up about 10 percent of mapped areas, but an individual area is less than 3 acres.

Most areas of this Hardeman soil are used for cultivated crops, and the potential is high for this use. This soil is suited to cotton, wheat, alfalfa, and grain sorghum. The hazard of water erosion is medium. Minimum tillage, winter cover crops, terracing, contour farming, and grassed waterways help to reduce erosion. Returning crop residue to the soil helps to improve fertility, reduce crusting, and increase water infiltration. The hazard of wind erosion is medium. Windbreaks, leaving crop residue on the surface, and tillage that leaves a rough surface help to protect the soil from wind erosion.

The potential is high for tame pasture and hayland. This soil is suited to alfalfa, bermudagrass, weeping lovegrass, and other adapted grasses and legumes. Use of this soil for tame pasture or hayland is effective in helping to control erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, deferred grazing, and restricted use during prolonged dry periods help to keep the pasture and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has high potential for use as rangeland. If management is good, the production of native grasses is high. The potential is high for trees as windbreaks; there are no serious limitations for trees on this soil. The potential is high for producing habitat for openland wildlife and rangeland wildlife.

This Hardeman soil has high potential for most building site developments and has medium potential for sanitary facilities. Seepage is the main limitation for sewage lagoons and sanitary landfills. Seepage from sewage lagoons can be prevented by special treatment to seal the bottom of the lagoon.

The potential is high for most recreational uses. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIIe, nonirrigated, and in subclass IIe, irrigated. It is in Sandy Prairie range site.

26—Hardeman fine sandy loam, 3 to 5 percent slopes. This deep, well drained, gently sloping soil is on side slopes on uplands. Most areas of this soil are parallel to the Salt Fork and Prairie Dog Town Fork of the Red River. Areas are irregular in shape and range from 20 to 80 acres.

Typically, the surface layer is reddish brown fine sandy loam about 9 inches thick. The subsoil is yellowish red fine sandy loam to a depth of about 53 inches. The underlying material to a depth of about 80 inches is yellowish red fine sandy loam.

Natural fertility and organic matter content are medium. The surface layer is mildly alkaline. The subsoil

is mildly alkaline or moderately alkaline to a depth of about 25 inches. It becomes moderately alkaline and calcareous below that depth. Permeability is moderately rapid, and surface runoff is medium. The available water capacity is medium. The surface layer is friable and easily tilled throughout a wide range of soil moisture. Root development is not restricted.

Included with this soil in mapping are small areas of Woodward and Aspermont soils on the higher lying positions. The included soils make up about 10 percent of mapped areas, but an individual area is less than 3 acres.

Most areas of this Hardeman soil are used for cultivated crops, and the potential is medium for this use. This soil is suited to cotton, wheat, and grain sorghum. The hazard of water erosion is medium. Minimum tillage, winter cover crops, terracing, contour farming, and grassed waterways help to reduce erosion. Returning crop residue to the soil helps to improve fertility, reduce crusting, and increase water infiltration. The hazard of wind erosion is medium. Windbreaks, leaving crop residue on the surface, and tillage that leaves a rough surface help to protect this soil from wind erosion.

The potential is medium for tame pasture and hayland. This soil is suited to alfalfa, bermudagrass, weeping lovegrass, and other adapted grasses and legumes. Use of this soil for tame pasture or hayland is effective in helping to control erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, deferred grazing, and restricted use during dry periods help to keep the pasture and soil in good condition. Fertilizing tame pasture grasses increases production of forage and improves the vigor of the plants.

This soil has high potential for use as rangeland. If management is good, the production of native grasses is high. The potential is high for trees as windbreaks; there are no serious limitations for trees on this soil. The potential is high for producing habitat for openland wildlife and rangeland wildlife.

This Hardeman soil has high potential for most building site developments and has medium potential for sanitary facilities. The main limitation for small commercial buildings is slope. Seepage is the main limitation for sewage lagoons and sanitary landfills. Seepage from sewage lagoons can be prevented by special treatment to seal the bottom of the lagoon.

The potential is high for most recreational uses. Slope limits the use of this soil for playgrounds. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIIe, irrigated and nonirrigated. It is in Sandy Prairie range site.

27—Hardeman fine sandy loam, 5 to 8 percent slopes. This deep, well drained, sloping soil is on convex side slopes on uplands, mainly adjacent to the Salt Fork and the Prairie Dog Town Fork of the Red River. This soil formed in moderately coarse textured eolian material blown from nearby streams. Areas are irregular in shape and range from 10 to 160 acres.

Typically, the surface layer is reddish brown fine sandy loam about 11 inches thick. The upper part of the subsoil is reddish brown fine sandy loam to a depth of 46 inches and the lower part is yellowish red fine sandy loam to a depth of 57 inches. The underlying material is yellowish red fine sandy loam to a depth of about 80 inches.

Natural fertility and organic matter content are medium. The surface layer is mildly alkaline or moderately alkaline. The subsoil is moderately alkaline. It is calcareous or noncalcareous in the upper part and is calcareous in the lower part. Permeability is moderately rapid, and surface runoff is medium. The available water capacity is medium. Root development is not restricted to a depth of 60 inches or more.

Included with this soil in mapping are a few small areas of Quinlan and Woodward soils along drainageways where red-bed material is exposed. The included soils make up about 5 percent of mapped areas, but an individual area is less than 3 acres.

This soil has low potential for cultivated crops. Slope, erosion, and runoff are the main concerns. Where these soils are cultivated, terracing, contour farming, grassed waterways, and crop residue management help to control erosion.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, and other adapted grasses and legumes. Slope is a limitation for use as hayland. The use of this soil as pastureland or hayland is effective in helping to control erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during prolonged dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has high potential as rangeland. If management is good, the production of native grasses is high. Brush and weed control is needed to maintain vigorous stands of native grasses. The potential is high for trees as windbreaks. Insufficient soil moisture is a limitation. The potential is high for producing habitat for openland wildlife and rangeland wildlife.

This Hardeman soil has high potential for most building site developments and has low potential for most sanitary facilities. The main limitation for small commercial buildings is slope. Seepage is a problem for sewage lagoons and sanitary landfills. Excessive seepage from sewage lagoons can be prevented by special treatment to seal the bottom of the lagoon.

The potential is high for most recreational uses. Excessive slope is a limitation for playgrounds. Onsite

investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IVe. It is in Sandy Prairie range site.

28—Hardeman fine sandy loam, 5 to 12 percent slopes, eroded. This deep, well drained, sloping to strongly sloping soil is on convex side slopes on uplands, mainly adjacent to the Salt Fork and Prairie Dog Town Fork of the Red River. This soil formed in moderately coarse textured eolian material blown from channels of nearby streams. Most areas are in old abandoned cropland that have been reseeded to grass or left idle to reseed to native grasses. Water erosion has removed the topsoil from more than 50 percent of areas. Rills and small crossable gullies are common. Areas are irregular in shape and range from 10 to 100 acres.

Typically, the surface layer is reddish brown fine sandy loam about 5 inches thick. The subsoil is reddish brown fine sandy loam to a depth of about 14 inches and yellowish red fine sandy loam to a depth of about 42 inches. The underlying material is yellowish red fine sandy loam or sandy loam to a depth of 80 inches or more.

Natural fertility and organic matter content are medium. The surface layer is mildly alkaline or moderately alkaline. The subsoil is moderately alkaline and calcareous. Permeability is moderately rapid, and surface runoff is rapid. The available water capacity is medium. Root development is not restricted to a depth of 60 inches or more.

Included with this soil in mapping are a few small areas of Knoco and Woodward soils along entrenched drainageways and some small areas of Aspermont soils. Also included are areas of soils that are similar to this Hardeman soil but have Permian shale or clay at a depth of 40 to 60 inches. The included soils make up about 10 percent of mapped areas, but an individual area is less than 3 acres.

This soil has low potential for cultivated crops. Slope, erosion, and surface runoff are the main concerns. This soil is better suited to native grasses or tame pasture than to most other crops.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, and other adapted grasses and legumes. Slope is a limitation for hayland. The use of this soil for pasture or hayland effectively helps to control erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during prolonged dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has high potential as rangeland. If management is good, this soil produces a large amount of native grasses. Brush and weed control is needed to maintain vigorous stands. The potential is high for trees as windbreaks; however, slope and insufficient soil moisture are limitations to trees on this soil. The potential is high for producing habitat for openland wildlife and rangeland wildlife.

This Hardeman soil has medium potential for most building site developments and has low potential for most sanitary facilities. Slope is the main limitation for shallow excavations, dwellings, small commercial buildings, and septic tank absorption fields. Seepage is the main limitation for sewage lagoons and sanitary landfills. Slope is a limitation for local roads and streets.

The potential is medium for most recreational uses. Slope is the main limitation. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass VIe. It is in Sandy Prairie range site.

29—Hardeman fine sandy loam, 8 to 12 percent slopes. This deep, well drained, strongly sloping soil is on convex side slopes on uplands, mainly adjacent to the Salt Fork and Prairie Dog Town Fork of the Red River. This soil formed in moderately coarse textured eolian material blown from channels of nearby streams. Areas are irregular in shape and range from 10 to 100 acres.

Typically, the surface layer is reddish brown fine sandy loam about 14 inches thick. The subsoil is reddish brown fine sandy loam to a depth of 29 inches and yellowish red, calcareous fine sandy loam to a depth of 56 inches. The underlying material is reddish yellow loamy fine sand to a depth of about 80 inches.

Natural fertility and organic matter content are medium. The surface layer is mildly alkaline or moderately alkaline, and the subsoil is moderately alkaline. Typically, the subsoil is noncalcareous in the upper part and calcareous in the lower part. Permeability is moderately rapid, and surface runoff is rapid. The available water capacity is medium. Root development is not restricted to a depth of 60 inches or more.

Included with this soil in mapping are a few small areas of Quinlan and Woodward soils along drainageways where red-bed material is exposed. The included soils make up about 5 percent of mapped areas, but an individual area is less than 3 acres.

This soil has low potential for cultivated crops. Slope, erosion, and surface runoff are the main concerns. This soil is better suited to native grasses or tame pasture than to most other crops.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, and other adapted grasses and legumes. Slope is a limitation for hayland. The use of this soil for pastureland

or hayland effectively helps to control erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during prolonged dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases production of forage and improves the vigor of the plants.

This soil has high potential as rangeland, and if management is good, it can produce a large amount of native grasses. Brush and weed control is needed to maintain vigorous stands of native grasses. The potential is high for trees as windbreaks; however, slope and insufficient moisture are limitations for growing trees on this soil. The potential is high for producing habitat for openland wildlife and rangeland wildlife.

This Hardeman soil has medium potential for most building site developments and has low potential for most sanitary facilities. Slope is the main limitation for shallow excavations, dwellings, small commercial buildings, and septic tank absorption fields. Seepage is the main limitation for sewage lagoons and sanitary landfills. Slope is a limitation for local roads and streets.

The potential is medium for most recreational uses. Slope is the main limitation. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass VIe. It is in Sandy Prairie range site.

30—Hardeman-Likes-Devol complex, 3 to 20 percent slopes. This complex consists of gently sloping to moderately steep, deep soils on uplands. The well drained Hardeman and excessively drained Likes soils are on side slopes and foot slopes. The well drained Devol soils are on ridgetops. Individual areas of these soils are so intermingled or so small that to separate them at the scale selected for mapping was not practical. Most areas of this complex are south of the Salt Fork of the Red River. Slope generally is 3 to 12 percent but ranges to 20 percent. Areas are irregular in shape and range from 10 to 1,500 acres.

The Hardeman soils make up about 35 percent of each mapped area. Typically, they have a surface layer of reddish brown fine sandy loam about 10 inches thick. The subsoil is reddish brown fine sandy loam to a depth of about 60 inches. The underlying material is yellowish red fine sandy loam to a depth of about 80 inches.

Hardeman soils are medium in natural fertility and organic matter content. The surface layer is mildly alkaline or moderately alkaline. The subsoil is moderately alkaline, and it is calcareous in the lower part. Permeability is moderately rapid, and surface runoff is rapid. The available water capacity is medium. The root zone is deep, and root penetration is not restricted.

The Likes soils make up about 30 percent of each mapped area. Typically, they have a surface layer of brown loamy fine sand about 11 inches thick. The underlying material is yellowish red gravelly sand to a depth of about 80 inches.

Likes soils are low in natural fertility and organic matter content. They are moderately alkaline and dominantly calcareous throughout. Permeability is rapid, and surface runoff is slow. The available water capacity is low. The root zone is deep, and root penetration is not restricted.

Devol soils make up about 15 percent of each mapped area. Typically, they have a surface layer of reddish brown fine sandy loam about 8 inches thick. The subsoil is reddish brown fine sandy loam to a depth of about 24 inches and reddish yellow fine sandy loam to a depth of about 38 inches. The underlying material is reddish yellow loamy fine sand to a depth of about 80 inches.

Devol soils are medium in natural fertility and organic matter content. The surface layer is neutral to mildly alkaline, and the subsoil ranges from neutral to moderately alkaline. Permeability is moderately rapid, and surface runoff is slow. The available water capacity is medium. The root zone is deep, and root penetration is not restricted.

Included with this complex in mapping are small areas of Grandfield, Quinlan, Woodward, and Yahola soils. Grandfield soils are on the ridgetops, Quinlan and Woodward soils are on steeper side slopes, and Yahola soils are on flood plains of the narrow drainageways. Also included are soils similar to this Hardeman soil, but the solum is 10 to 20 inches thick over sandstone and shale of Permian age. The included soils make up about 20 percent of mapped areas, but an individual area is less than 5 acres.

The potential is low for cultivated crops. The main concerns are steep slopes, soil erosion, and droughtiness.

This complex has medium potential for tame pasture and hayland. Concerns are steep slopes, soil erosion, water erosion, and droughtiness. Careful management is needed to control stocking rates, to insure protective soil cover, and to maintain the quality of grasses. Diversion terraces decrease runoff and reduce erosion. Control of brush and weeds increases the quality and quantity of tame pasture grasses.

This complex has medium potential for rangeland. Careful management is needed to control stocking rates and time of grazing because the grasses are easily damaged during periods of drought. Control of brush is needed to maintain the quality of native range (fig. 7). If management is good, the production of native grasses is medium. The potential is low for trees as windbreaks. Limitations are steep slopes and droughtiness. The potential is high for producing habitat for openland wildlife and rangeland wildlife.

Figure 7.—Yucca and sand sagebrush are common on Hardeman-Likes-Devol complex, 3 to 20 percent slopes. Range site is Sandy Prairie on Devol and Hardeman soils and Deep Sand on Likes soil.

The soils in this complex have low potential for most building site developments and sanitary facilities. The steepness of slope is the main limitation for septic tank absorption fields, dwellings, and small commercial buildings. Seepage is the main limitation for sewage lagoons and sanitary landfills. Steep slopes are the main limitation for local roads and streets.

The potential is low for most recreational uses. Steep slopes are the main limitation. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This complex is in capability subclass VIe. The Hardeman and Devol soils are in Sandy Prairie range site, and the Likes soils are in Deep Sand range site.

31—Hollister silty clay loam, 0 to 1 percent slopes. This deep, well drained, nearly level soil is on broad flat uplands. Areas are irregular in shape and range from 15 to 120 acres.

Typically, the surface layer is very dark grayish brown silty clay loam about 6 inches thick. The subsoil is very dark grayish brown silty clay loam to a depth of about 21 inches, very dark grayish brown, brown, and reddish brown clay to a depth of about 70 inches, and yellowish red silty clay loam to a depth of about 80 inches.

Natural fertility and organic matter content are high. The surface layer and upper part of the subsoil are mildly alkaline or moderately alkaline. The lower part of the subsoil is moderately alkaline and calcareous. Permeability and surface runoff are slow. The available water capacity is high. The soil has fair tilth and can be worked only in a limited range of soil moisture. The root zone is deep, but root penetration is somewhat restricted in the subsoil because of the clayey texture.

Included with this soil in mapping are a few small areas of Tillman soils on the more convex positions. Included soils make up about 15 percent of mapped areas, but an individual area is less than 2 acres.

Nearly all areas of this Hollister soil are used for cultivated crops, and the potential is high for this use. This soil is suited to wheat, cotton, and grain sorghum. The hazard of water erosion is slight. Minimum tillage, winter cover crops, and residue management help to

prevent soil loss, improve fertility, reduce surface crusting, and increase water infiltration.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, alfalfa, and other adapted grasses and legumes. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during excessively wet and dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has medium potential for rangeland. If management is good, production of native grasses is medium. The potential is low for trees as windbreaks. Insufficient soil moisture is the main limitation. The dense clayey subsoil restricts root development and penetration. The potential is high for producing habitat for openland wildlife and medium for producing habitat for rangeland wildlife.

This Hollister soil has low potential for most building site developments and sanitary facilities. Shrink-swell is the main limitation for dwellings, roads and streets, and small commercial buildings. This can be corrected by proper design and installation procedures. The slow permeability is a concern for septic tank absorption fields, but this can be overcome by increasing the size of the absorption field. This soil has slight limitations for sewage lagoons and sanitary landfills.

The potential is high for all recreational uses; there are no significant limitations. Onsite investigation is necessary to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIc, nonirrigated and in capability class I, irrigated. It is in Hardland range site.

32—Knoco-Aspermont complex, 3 to 12 percent slopes, gullied. This complex consists of the very shallow, well drained to excessively drained Knoco soils and the moderately deep and deep, well drained Aspermont soils. The Knoco soils are on middle and lower side slopes, and the Aspermont soils are on upper slopes and broad convex ridgetops. Most areas of this complex have been cultivated, and the soils are so eroded that further cultivation is impractical. Common gullies are 5 to 30 feet wide, 2 to 8 feet deep, and 100 to 300 feet apart. They make up as much as 10 percent of mapped areas. The subsoil is exposed on the surface in more than 75 percent of the acreage. Individual areas of these soils are so intermingled or so small that to separate them at the scale selected for mapping was not practical. Areas are irregular in shape and range from 20 to 200 acres.

The Knoco soils make up about 48 percent of each mapped area. Typically, they have a surface layer of red silty clay about 8 inches thick. The underlying material is weathered, interbedded, red and olive gray shale to a depth of 40 inches or more.

Knoco soils are low in natural fertility and organic matter content. They are moderately alkaline and calcareous throughout. Permeability is very slow, and runoff is rapid. The available water capacity is very low. Rooting is restricted to a depth of less than 12 inches because of dense shale.

The Aspermont soils make up about 26 percent of each mapped area. Typically, they have a surface layer of reddish brown silt loam about 6 inches thick. The subsoil to a depth of about 35 inches is red clay loam. The underlying material is reddish brown clay loam to a depth of about 80 inches.

Aspermont soils are low in natural fertility and organic matter content. They are moderately alkaline and typically calcareous throughout. Permeability is moderate, and runoff is rapid. The available water capacity is medium.

Included with this complex in mapping are a few small areas of Vernon soils in positions on the landscape between the Aspermont and Knoco soils. The included soils make up about 26 percent of mapped areas, but an individual area is generally less than 5 acres.

All of the areas of this complex are used for rangeland, and the potential for this use is low. The low fertility, shallow rooting depth, strong slopes, and very low available water capacity of the Knoco soils and the strong slopes and low fertility of the Aspermont soils limit the production of native grasses. If management is good, production of native grasses is low on Knoco soils and medium on Aspermont soils.

The potential is very low for cultivated crops. These soils are not suited to cultivation because of the shallow depth and strong slopes.

This complex has low potential for tame pasture and hayland. The soils are best suited to mixed native grasses and improved old world bluestems in a pasture seeding program. The potential is low for trees as windbreaks. The shallow depth to bedrock, strong slopes, and very low available water capacity are the main limitations of the Knoco soils. Strong slopes are the main limitation of the Aspermont soils. The potential is low for producing habitat for openland and rangeland wildlife.

This complex has low potential for most building site developments and sanitary facilities. The very slow permeability of the Knoco soils is a limitation for septic tank absorption fields, and the high shrink-swell potential is a concern for most other uses. The Aspermont soils are better suited for these uses than the very shallow Knoco soils.

The potential is low for most recreational uses. Slope, very slow permeability, clayey surface texture, and depth to bedrock of the Knoco soils are the main limitations. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This complex is in capability subclass VIe. The Knoco soils are in Eroded Red Clay range site, and the Aspermont soils are in Eroded Prairie range site.

33—Knoco-Badland association, gently sloping. This map unit consists of very shallow, well drained to excessively drained Knoco soils and areas of Badland in regular, repeating patterns. The landscape consists of geologically eroded, very gently sloping to moderately steep low knobs and raw escarpments that are down-wearing into the surrounding uplands. The Knoco soils are on narrow ridges and broad erosional flats. The Badland is on escarpments, raw knobs, and where the raw shale is exposed on erosional flats. Slope generally is 1 to 5 percent but ranges to 15 percent. Areas are irregular in shape and range from 10 to 1,500 acres.

Knoco soils make up about 56 percent of each mapped area. Typically, they have a surface layer of red clay about 9 inches thick. The underlying material is red, calcareous shale to a depth of about 40 inches.

Knoco soils are low in natural fertility and organic matter content. They are moderately alkaline and calcareous throughout. Permeability is very slow, and surface runoff is rapid. The available water capacity is very low. Rooting is restricted to a depth of less than 12 inches because of dense clayey shale or shale.

The Badland makes up about 29 percent of each mapped area. Typically, Badland consists of very gently sloping to moderately steep barren land. Geologic erosion is active. Areas consist of red clay beds, shales, and gypsiferous shales of Permian age and have entrenched, intermittent streams.

Badland materials are low in natural fertility and organic matter content. They are moderately alkaline and are calcareous. Permeability is very slow, and surface runoff is very rapid. The available water capacity is very low. Badland is a source of large amounts of silty and clayey sediment. The very shallow root zone greatly restricts the establishment of most plants.

Included with this unit in mapping are a few areas of moderately deep Vernon soils on remnants of ridges and flats that have not been eroded, Quinlan soils where remnants of sandstone remain, and Aspermont soils on upper side slopes. Also included throughout mapped areas are small areas of outcrops of gypsum and shallow Cornick soils that are associated with the gypsum. The included soils and outcrops make up about 15 percent of mapped areas, but an individual area is less than 20 acres.

Most areas of this map unit are used for rangeland, and the potential is low for this use. If management is good, the production of native grasses is low. Plant composition and vigor can be maintained or improved by weed and brush control.

This map unit is not suited to cultivated crops, tame pasture, or hayland. The potential is low for all these uses. Shallow depth to bedrock, dense clayey surface texture, rapid surface runoff, and erosion are the main hazards and limitations.

This map unit is not suited to trees as windbreaks. Depth to bedrock, dense clayey texture, and low available water capacity are the main limitations and erosion is a hazard to the successful establishment and growth of trees. The potential is low for producing habitat for openland and rangeland wildlife.

This map unit has low potential for most building site developments and sanitary facilities. High shrink-swell potential is the main limitation for dwellings, small commercial buildings, and local roads and streets. Depth to rock is the main limitation for sewage lagoons, trench type sanitary landfills, and shallow excavations. Very slow permeability and depth to rock are the main limitations for septic tank absorption fields.

The potential is low for most recreational uses. The main limitations are clayey texture and depth to bedrock. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This map unit is in capability subclass VIIs. The Knoco soils are in Red Clay Prairie range site, and Badland is in Eroded Red Clay range site.

34—Knoco-Cornick-Rock outcrop complex, 2 to 20 percent slopes. This complex consists of very shallow, well drained to excessively drained Knoco and Cornick soils and Rock outcrop on uplands. The landscape consists of rough broken areas that are capped with gypsum and dolomitic limestone. It has the appearance of a series of ledges or steps. The Knoco soils are strongly sloping to moderately steep and are on side slopes between the rock ledges. The Cornick soils are very gently sloping and gently sloping and are on small ridges and upper side slopes. The Rock outcrop occurs as flat caprock at various elevations throughout mapped areas. The Knoco soils formed in calcareous shale and clay, and the Cornick soils formed in material weathered from gypsum. Individual areas of these soils and Rock outcrop are so intermingled or so small that to separate them at the scale selected for mapping was not practical. Slope is dominantly 2 to 20 percent but in some areas ranges to 40 percent. Areas of this complex are mainly in the northern part of the county. They are irregular in shape and range from 50 to 3,000 acres.

The Knoco soils make up about 21 percent of each mapped area. Typically, they have a surface layer of reddish brown clay about 10 inches thick. The underlying material is weathered, interbedded reddish brown and light gray shaly clay to a depth of 30 inches or more.

Knoco soils are low in natural fertility and organic matter content. They are moderately alkaline and calcareous throughout. Permeability is very slow, and runoff is excessive. Available water capacity is very low. Rooting is restricted to a depth of less than 12 inches because of dense shale.

Figure 8.—An area of Knoco-Cornick-Rock outcrop complex, 2 to 20 percent slopes. Typically, mesquite is common. Range site is Red Clay Prairie for the Knoco soil and Gyp for the Cornick soil.

The Cornick soils make up about 21 percent of each mapped area. Typically, they have a surface layer of reddish brown silt loam about 9 inches thick. The underlying material is white gypsum to a depth of 20 inches.

Cornick soils are high in natural fertility and organic matter content. They are moderately alkaline and calcareous throughout. Permeability is moderate, and runoff is rapid. The available water capacity is very low. Gypsum restricts rooting to a depth of about 9 inches.

Rock outcrop makes up about 19 percent of each mapped area. It is exposed, bare, soft gypsum and hard limestock bedrock. Surface runoff is very rapid.

Included with this complex in mapping are small areas of Vinson, Aspermont, Quanah, and Talpa soils. The included soils make up about 39 percent of mapped areas, but an individual area is generally less than 5 acres.

All areas of this complex are used for rangeland (fig. 8). The potential is low for rangeland because of very low available water capacity, slope, and a restricted root zone caused by shallowness over rock or shale. If management is good, the production of native grasses is low.

The soils in this complex are not suited to cultivation, tame pasture, or hayland. Potential is low for these uses. Slope, shallow depth to bedrock, and excessive runoff are the main limitations. These soils are not suited to trees as windbreaks. Very low available water, slope, and shallowness to bedrock are the main limitations. The potential is low for producing habitat for openland wildlife and rangeland wildlife.

The soils in this complex have low potential for most building site developments and sanitary facilities. Steepness of slope, very shallow depth to bedrock, and high shrink-swell potential are limitations that are difficult to overcome.

Figure 9.—An area of Knoco-Rock outcrop complex, 20 to 40 percent slopes, in background. The Knoco soil is in Breaks range site. Mangum and Spur soils are in foreground.

The potential is low for most recreational uses. The very slow permeability in the Knoco soils, slope, and the depth to bedrock are severe limiting features. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This complex is in capability subclass VIIs. The Knoco soils are in Red Clay Prairie range site, the Cornick soils are in Gyp range site, and Rock outcrop is not assigned to a range site.

35—Knoco-Rock outcrop complex, 20 to 40 percent slopes. This complex consists of very shallow, well drained to excessively drained, steep Knoco soils and Rock outcrop on uplands. The landscape consists of steep escarpments and canyons incised in smoother uplands. The Knoco soils are on steep side slopes between caprock ledges (fig. 9). The Rock outcrop occurs as flat caprock at various elevations. Individual areas of the Knoco soils and Rock outcrop are so intermingled or so small that to separate them at the scale selected for mapping was not practical. Areas of this complex are mainly in the northern part of the county. They range from 20 to 2,000 acres.

The Knoco soils make up about 60 percent of each mapped area. Typically, they have a surface layer of red clay about 6 inches thick. The underlying material is weakly consolidated, red clayey shale.

Knoco soils are low in natural fertility and organic matter content. These soils are moderately alkaline and calcareous throughout. Permeability is very slow, and surface runoff is rapid. The available water capacity is very low. Root penetration is restricted to a depth of about 12 inches because of hard shale or dense clay.

Rock outcrop makes up about 20 percent of each mapped area. It consists of exposed areas of bare soft gypsum, shale and clayey shale, and hard limestone bedrock. Geologic erosion is active, and surface runoff is very rapid.

Included with this complex in mapping are small areas of Cornick and Talpa soils. The included soils make up about 20 percent of mapped areas, but an individual area is generally less than 5 acres.

All areas of this complex are used for rangeland. The potential is low for this use. Steep slopes and shallow depth to bedrock are the main limiting features.

This complex is not suited to cultivated crops, tame pasture, or hay because of steep slopes, shallow soils, and Rock outcrop. The potential for these uses is low. This complex is not suited to trees as windbreaks. Steep slopes and insufficient soil moisture severely limit tree growth. The potential is low for producing habitat for openland and rangeland wildlife.

This complex has low potential for most building site developments and sanitary facilities. Depth to bedrock, steep slopes, and very slow permeability are limiting features.

The potential is low for most recreational uses. Steep slopes, very slow permeability, and depth to bedrock are limiting features. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This complex is in capability subclass VIIs. The Knoco soils are in Breaks range site, and Rock outcrop is not assigned to a range site.

36—Likes fine sand, hummocky. This deep, excessively drained, gently sloping to sloping soil is in hummocky, dune areas on flood plains, mainly along the Salt Fork and the Prairie Dog Town Fork of the Red River. Slope ranges from 3 to 8 percent. Areas are generally long and narrow and range from 10 to 70 acres.

Typically, the surface layer is reddish yellow fine sand about 6 inches thick. The underlying material is reddish yellow fine sand to a depth of about 80 inches.

Natural fertility and organic matter content are low. The pedon is moderately alkaline throughout. Permeability is rapid, and surface runoff is very slow. The available water capacity is low. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are a few small areas of Lincoln soils in low positions between the dunes. The included soils make up about 10 percent of the mapped areas, but an individual area is generally less than 5 acres.

Most areas of this soil are used for rangeland, and the potential is medium for this use. Yields are affected by the low available water capacity and the sandy texture. If management is good, the production of native grasses is medium.

The potential is low to medium for tame pasture and hayland. The low available water capacity, slope, and sandy texture are the main limitations. This soil is suited to bermudagrass, weeping lovegrass, and other adapted grasses and legumes. The use of this soil for tame pasture or hayland is effective in helping to control wind erosion. Establishing a grass stand on this soil can be difficult because of seedling mortality caused by wind erosion. Overgrazing during dry periods causes the grass stand to die out and increases erosion. Proper stocking rates, restricted use during dry periods, and timely deferment and rotation of grazing help to keep the grasses and the soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil is not suited to cultivated crops. The severe hazard of wind erosion and the low available water capacity are the main concerns. The potential is medium for trees as windbreaks. Wind erosion and insufficient soil moisture during summer present difficulties in the establishment of young trees. The potential is low for producing habitat for openland wildlife and is medium for producing habitat for rangeland wildlife.

This Likes soil has medium potential for most building site developments and has low potential for most sanitary facilities. Seepage is the main limitation for sanitary landfills and sewage lagoons. The percolation rate is so rapid that it is a poor filter for septic tank absorption fields. There are no significant limitations for the use of this soil for dwellings and local roads and streets. Slope is the main limitation for small commercial buildings.

The potential is low for most recreational uses. The sandy texture is the main limitation. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass VIe. It is in Deep Sand range site.

37—Lincoln loamy fine sand, frequently flooded. This deep, somewhat excessively drained, nearly level soil is on flood plains, mainly along the Salt Fork and Prairie Dog Town Fork of the Red River. This soil is subject to frequent flooding. Slope is 0 to 1 percent. Areas are irregular in shape and range from 10 to 300 acres.

Typically, the surface layer is light brown loamy fine sand about 9 inches thick. The underlying material is calcareous, light brown loamy fine sand and pink fine sand to a depth of about 80 inches. Thin bedding planes are evident.

Natural fertility and organic matter content are low. The pedon is moderately alkaline and calcareous throughout. Permeability is rapid, and runoff is slow. The available water capacity is low. The surface layer is loose and, where tilled, is subject to severe wind erosion. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are a few areas of Likes soils on the higher positions and Gracemore soils on slightly lower positions. The Gracemore soils are saline and have a water table within a depth of 40 inches. Also included are small areas of Yahola soils. The included soils make up about 20 percent of mapped areas, but an individual area generally is less than 5 acres.

Most areas of this Lincoln soil are used for rangeland, and the potential is medium for this use. Yields are adversely affected by low available water capacity and

sandy texture. If management is good, the production of native grasses is medium.

The potential is low for cultivated crops. Frequent flooding is a major hazard. The flooding can cause soil damage and loss of crops. Maintaining fertility and controlling wind erosion are major management concerns. These soils are better suited to grasses than to most other crops.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, and other adapted grass and legumes. Overgrazing or grazing when the soil is too dry can reduce the grass stand and lower the vigor of the grasses. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during extremely wet or dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has medium potential for trees as windbreaks. Frequent flooding is the main hazard in establishing trees. The potential is medium for producing habitat for openland and rangeland wildlife.

This Lincoln soil has low potential for most building site developments and sanitary facilities. Flooding and seepage are the main limiting factors for sewage lagoons and sanitary landfills. Flooding and poor filter materials are major concerns for septic tank absorption fields. Flooding is the main hazard for dwellings, small commercial buildings, and local roads and streets. The sandy texture is a limitation for shallow excavations.

The potential is low for most recreational uses. Flooding and the sandy surface layer are the main limiting features. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass Vw. It is in Sandy Bottomland range site.

38—Madge loam, 0 to 1 percent slopes. This deep, well drained, nearly level soil is on broad, flat or slightly concave positions on uplands. Isolated areas mainly are north of the Salt Fork of the Red River. They are irregular in shape and range from 10 to 300 acres.

Typically, the surface layer is dark brown loam about 14 inches thick. The subsoil is reddish brown clay loam to a depth of about 26 inches, yellowish red clay loam to a depth of about 43 inches, and reddish yellow loam to a depth of about 58 inches. The underlying material is red loam to a depth of about 80 inches.

Natural fertility and organic matter content are high. The surface layer is slightly acid to mildly alkaline, and the subsoil is neutral to moderately alkaline. Permeability is moderate, and surface runoff from cultivated areas is slow. The available water capacity is high. The surface layer is friable and easily tilled throughout a fairly wide range of soil moisture. It tends to crust after hard rains. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are a few small areas of Abilene soils at the head of upland drainageways. The included soils make up about 5 percent of mapped areas, but an individual area is less than 3 acres.

Most areas of this Madge soil are used for cultivated crops. This soil has high potential for this use and is suited to wheat, grain sorghum, and cotton. The hazard of wind erosion is moderate. Minimum tillage, winter cover crops, and residue management help to prevent erosion, improve fertility, reduce surface crusting, and increase water infiltration.

The potential is high for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, alfalfa, and other adapted grasses and legumes. Use of this soil for tame pasture or hayland helps to control wind and water erosion. Overgrazing or grazing when the soil is too wet or too dry may cause compaction and restrict root development. Proper stocking rates, timely deferment of grazing, and restricted use during wet or droughty conditions help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has high potential for use as rangeland, although very few areas are used for this purpose. If management is good, production of native grasses is high. The potential is high for trees as windbreaks. The potential is high for producing habitat for openland and rangeland wildlife.

This Madge soil has high potential for most building site developments and has medium potential for most sanitary facilities. Seepage is a concern for sewage lagoons, but this can be overcome by special treatment to seal the bottom of the lagoon.

The potential is high for most recreational uses. This soil is easily eroded where it is used for paths and trails. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIc, nonirrigated, and in capability class I, irrigated. It is in Loamy Prairie range site.

39—Madge loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on convex ridgetops on uplands, mainly in the northern part of the county north of the Salt Fork of the Red River. Areas are irregular in shape and range from 5 to 100 acres.

Typically, the surface layer is reddish brown and dark reddish gray loam about 13 inches thick. The subsoil is reddish brown clay loam to a depth of 25 inches, reddish brown sandy clay loam to a depth of about 41 inches, and red loam to a depth of about 57 inches. The underlying material is red fine sandy loam to a depth of about 80 inches.

Figure 10.—Sprinkler-irrigated alfalfa in an area of Madge loam, 1 to 3 percent slopes.

Natural fertility and organic matter content are high. The surface layer is slightly acid to mildly alkaline, and the subsoil is neutral to moderately alkaline. Permeability is moderate, and surface runoff is medium. The available water capacity is high. The surface layer is friable and easily tilled throughout a fairly wide range of soil moisture. It tends to crust after hard rains. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are small areas of Shrewder fine sandy loam on convex knolls. The included soils make up about 5 percent of mapped areas, but an individual area is less than 3 acres.

Most areas of this Madge soil are used for cultivated crops. This soil has high potential for cultivated crops and is suited to wheat, grain sorghum, and cotton. If this soil is cultivated, the hazards of wind and water erosion are moderate. Minimum tillage, terracing and contour farming, grassed waterways, winter cover crops and residue management help to reduce soil loss, improve fertility, reduce surface crusting, and increase water infiltration.

The potential is high for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, alfalfa (fig. 10), and other adapted grasses and legumes. Overgrazing or grazing when the soil is too wet may cause compaction and restrict root development. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or droughty conditions help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has high potential for use as rangeland, although very few areas are used for this purpose. If management is good, the production of native grasses is high. The potential is high for trees as windbreaks. The potential is high for producing habitat for openland and rangeland wildlife.

This Madge soil has high potential for most building site developments and sanitary facilities. Seepage is a concern for sewage lagoons, but this can be overcome by special treatment to seal the bottom of the lagoon.

The potential is high for most recreational uses. This soil is easily eroded where it is used for paths and trails. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIe, irrigated and nonirrigated. It is in Loamy Prairie range site.

40—Mangum silty clay loam, occasionally flooded. This deep, well drained, nearly level soil is on flood plains, mainly along Turkey Creek and its tributaries. The flood plains are subject to occasional flooding. Slope is 0 to 1 percent. Areas are irregular in shape and range from 10 to 300 acres.

Typically, the surface layer is red silty clay loam about 7 inches thick. The subsoil is red clay to a depth of 21 inches. The underlying material is red clay with thin strata of loam and fine sandy loam to a depth of 65 inches.

Natural fertility and organic matter content are medium. The pedon is moderately alkaline and calcareous throughout. Permeability is very slow, and surface runoff is slow. The available water capacity is high. The rooting zone is deep, but root penetration is restricted by the dense clayey subsoil in most areas.

Included with this soil in mapping are a few small areas of Clairemont soils on old natural levees, Beckman soils on low positions, and Spur soils throughout mapped areas. The included soils make up about 20 percent of mapped areas, but an individual area is less than 5 acres.

About 70 percent of the areas of this Mangum soil is used for cultivated crops and the potential is medium for this use. This soil is suited to wheat, grain sorghum, and cotton. The hazard of water erosion is slight. Surface crusting, dense clayey texture, very slow permeability, and occasional flooding are the main concerns. Dikes and levees have been installed in some areas to direct overflow from cultivated fields. Minimum tillage, winter cover crops, and return of crop residue to the soil help to improve fertility, reduce crusting, and increase water infiltration.

The potential is high for tame pasture and hayland. This soil is suited to bermudagrass and other adapted grasses and legumes. Alfalfa is grown in some areas that are irrigated, but overflow may damage the crop stand. Overgrazing or grazing when the soil is too wet or too dry causes surface compaction, results in poor tilth, and reduces water infiltration. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during prolonged wet or dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases forage production and improves the vigor of the plants.

This soil has high potential for use as rangeland. If management is good, production of native grasses is high. The potential is low for trees as windbreaks. The dense clayey texture, insufficient soil moisture, and occasional overflow increase seedling mortality and restrict tree growth. The potential is high for producing habitat for openland wildlife and medium for producing habitat for rangeland wildlife.

This soil has low potential for most building site developments and sanitary facilities. Flooding and shrink-swell potential are the main limiting features for dwellings, small commercial buildings, and local roads and streets. Flooding is the main hazard for sanitary landfills, sewage lagoons, septic tank absorption fields, and shallow excavations.

The potential is low for most recreational uses. The very slow permeability is the main limitation for picnic areas and playgrounds. Flooding is the main limitation for camp areas, playgrounds, and golf fairways. Onsite investigation is necessary to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIw, nonirrigated and irrigated. It is in Heavy Bottomland range site.

41—Mangum silty clay, rarely flooded. This deep, well drained, nearly level, clayey soil is on flood plains, mainly along Elm and Turkey Creeks. The flood plains are subject to rare flooding. Slope is 0 to 1 percent. Areas are irregular in shape and range from 10 to 160 acres.

Typically, the surface layer is reddish brown silty clay about 11 inches thick. The subsoil is reddish brown silty clay to a depth of about 37 inches and yellowish red silty clay to a depth of about 57 inches. The underlying material is red silty clay to a depth of 80 inches or more.

Natural fertility and organic matter content are medium. The pedon is moderately alkaline and calcareous throughout. Permeability is very slow, and surface runoff is slow. The available water capacity is high. This soil can be tilled only in a limited range of soil moisture. It forms a surface crust easily after hard rains. The rooting zone is deep, but root development is restricted below a depth of 20 inches because of the dense clayey subsoil.

Included with this soil in mapping are a few small areas of Clairemont soils along old natural levees, Beckman soils in low positions, and Spur soils along narrow drainageways coming out of the uplands. The included soils make up about 20 percent of mapped areas, but an individual area is less than 5 acres.

About 70 percent of the areas of this Mangum soil is used for cultivated crops. The soil has medium potential for cultivated crops and is suited to wheat, grain sorghum, and cotton. The hazard of water erosion is slight. Surface crusting, dense clayey texture, and very slow permeability are the main limiting features. Minimum tillage, winter cover crops, and return of crop residue

help to improve fertility, reduce crusting, and increase water infiltration.

The potential is medium for tame pasture and hayland. Bermudagrass is suitable if irrigated; if not irrigated production is low. Overgrazing or grazing when the soil is too wet or too dry causes surface compaction, results in poor tilth, and reduces water infiltration. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during prolonged wet or dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has high potential for use as rangeland. If management is good, the production of native grasses is high. The potential is low for use of trees as windbreaks. The dense clayey texture and insufficient soil moisture increase seedling mortality and restrict tree growth. The potential is high for producing habitat for openland wildlife and is medium for producing rangeland wildlife.

This Mangum soil has low potential for most building site developments and sanitary facilities. Shrink-swell potential and flooding are limiting features for dwellings, small commercial buildings, and local roads and streets. Flooding is the main hazard for area type sanitary landfills. The clayey texture is the main limitation for trench type sanitary landfills and shallow excavations. The very slow permeability is the main limitation for septic tank absorption fields.

The potential is low for most recreational uses. Clayey texture, very slow permeability, and flooding are the main concerns. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIIs, nonirrigated, and in capability subclass IIs, irrigated. It is in Heavy Bottomland range site.

42—McKnight loamy fine sand, 0 to 3 percent slopes. This moderately deep and deep, well drained, nearly level and very gently sloping soil is on convex ridges and side slopes on uplands. Areas are irregular in shape and range from 10 to 150 acres.

Typically, the surface layer is yellowish red loamy fine sand about 8 inches thick. The subsoil is reddish brown sandy clay loam to a depth of about 23 inches, yellowish red sandy clay loam to a depth of about 33 inches, and red clay to a depth of about 45 inches. The underlying material is red, clayey shale to a depth of about 60 inches.

Natural fertility is medium, and organic matter content is low. The surface layer and subsoil are neutral to moderately alkaline. The lower part of the subsoil is calcareous. Permeability and surface runoff are slow. The available water capacity is medium. The surface layer is loose and easily tilled throughout a wide range of soil moisture. Root development is restricted at a depth of 45 inches by the dense clay or shale.

Included with this soil in mapping are a few small areas of Devol and Grandfield soils on small ridgetops. The included soils make up about 15 percent of mapped areas, but an individual area is generally less than 5 acres.

Most areas of this McKnight soil are used for cultivated crops, and the potential is medium for this use. This soil is suited to wheat, cotton, and grain sorghum. Where cultivated crops are grown, the hazard of wind erosion is severe, and very intensive conservation measures are required. Minimum tillage, residue management, cover crops, contour farming, terraces, windbreaks, and grassed waterways help to prevent soil loss.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, and other adapted grasses and legumes. The use of this soil for tame pasture or hayland effectively helps to control erosion. Overgrazing the grass during dry periods causes the stand to die out. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has medium potential for use as rangeland. If management is good, the production of native grasses is medium. The potential is medium for use of trees as windbreaks. Root development is restricted by dense clay or shale. The potential is medium for producing openland wildlife habitat and high for producing habitat for rangeland wildlife.

This McKnight soil has medium potential for most building site developments and sanitary facilities. Depth to rock is a concern for sewage lagoons, and the slow permeability is the main limitation for septic tank absorption fields. The clayey texture of the underlying material is a limitation for trench type sanitary landfills. Shrink-swell potential is the main limitation for dwellings with basements.

The potential is high for most recreational uses. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIIe. It is in Deep Sand range site.

43—McKnight loamy fine sand, 2 to 5 percent slopes, eroded. This moderately deep and deep, well drained, very gently sloping and gently sloping soil is on eroded, convex slopes on uplands. The subsoil is exposed on the surface because of erosion in most areas, and small crossable gullies are common. Areas are irregular in shape and range from 10 to 150 acres.

Typically, the surface layer is yellowish red loamy fine sand to a depth of about 7 inches. The subsoil to a depth of about 35 inches is red and reddish brown sandy clay loam and red clay loam to a depth of 50 inches.

The underlying material is red, weakly consolidated sandstone to a depth of about 80 inches.

Natural fertility is medium, and organic matter content is low. The surface layer is neutral or mildly alkaline, and the subsoil is neutral to moderately alkaline. The underlying material is moderately alkaline and calcareous. Permeability is slow, and surface runoff from cultivated areas is high. The available water capacity is medium. The surface layer is loose and easily tilled throughout a wide range of soil moisture. Root development is restricted at a depth of about 50 inches by dense clay, shale, or sandstone.

Included with this soil in mapping are a few small areas of Devol and Grandfield soils on upper side slopes and small ridgetops. Also included are a few small areas of Aspermont and Vernon soils. The included soils make up about 15 percent of the mapped areas, but an individual area is generally less than 5 acres.

Most areas of this McKnight soil are used for cultivated crops, and the potential is low for this use. This soil is suited to cotton, wheat, and grain sorghum, and yields can be fair if management is intensive. The hazards of wind and water erosion are very severe where cultivated crops are grown. Minimum tillage, cover crops, terraces, contour farming, grassed waterways, windbreaks, and residue management help to reduce soil loss and conserve soil moisture.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, and other adapted grasses and legumes for hay and pasture. The use of this soil for tame pasture and hayland effectively helps to control erosion. Overgrazing, especially during dry periods, can cause the grass stand to die out. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has medium potential for use as rangeland. If management is good, the production of native grasses is medium. The potential is medium for trees as windbreaks. Slope, erosion, and restricted root development caused by dense clay or shale are the main limitations. The potential is medium for producing habitat for openland wildlife and is high for producing habitat for rangeland wildlife.

This McKnight soil has medium potential for most building site developments and sanitary facilities. Depth to rock is a limitation for sewage lagoons, and slow permeability is the main limitation for septic tank absorption fields. The clayey texture of the underlying material is a limitation for trench type sanitary landfills. Shrink-swell potential is the main limitation for dwellings with basements.

The potential is high for most recreational uses. Slope is a limitation for playgrounds. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IVe. It is in Deep Sand range site.

44—McKnight fine sandy loam, 1 to 3 percent slopes. This moderately deep and deep, well drained, very gently sloping soil is on convex ridgetops and side slopes on uplands. Areas are irregular in shape and range from 10 to 150 acres.

Typically, the surface layer is reddish brown fine sandy loam to a depth of about 7 inches. The subsoil is reddish brown sandy clay loam to a depth of about 25 inches, red sandy clay loam to a depth of about 35 inches, and red clay to a depth of about 53 inches. The underlying material is red clayey shale to a depth of about 80 inches.

Natural fertility is medium, and organic matter content is low. The surface layer is mildly alkaline, and the upper part of the subsoil is moderately alkaline. The lower part of the subsoil and the underlying material are moderately alkaline and are calcareous. Permeability and surface runoff are slow. The available water capacity is medium. The surface layer is friable and easily tilled throughout a wide range of soil moisture. Root development is restricted below a depth of 53 inches by dense clay or shale.

Included with this soil in mapping are a few areas of Devol and Grandfield soils on small ridgetops. Also included are a few small intermingled areas of Aspermont and Vernon soils. The included soils make up about 15 percent of mapped areas, but an individual area is generally less than 5 acres.

Most areas of this McKnight soil are used for cultivated crops, and the potential is medium for this use. This soil is suited to wheat, cotton, and grain sorghum.

The hazard of wind erosion is moderate where cultivated crops are grown, and intensive conservation measures are required. Minimum tillage, residue management, cover crops, contour farming, terracing, windbreaks, and grassed waterways help to prevent soil loss.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, and other adapted grasses and legumes. The use of this soil for tame pasture or hayland effectively helps to control erosion. Overgrazing during dry periods causes the grass stand to die out. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has medium potential for use as rangeland. If management is good, the production of native grasses is medium. The potential is medium for use of trees as windbreaks. Root development is restricted by dense

clay or shale. The potential is high for producing habitat for openland wildlife and rangeland wildlife.

This McKnight soil has medium potential for most building site developments and sanitary facilities. Depth to rock is a concern for sewage lagoons, and slow permeability is the main limitation for septic tank absorption fields. The clayey texture of the underlying material is a severe limitation for trench type sanitary landfills. Shrink-swell potential is the main limitation for dwellings with basements.

The potential is high for most recreational uses. Onsite investigation is essential to properly evaluate and plan development of specified sites for all uses.

This soil is in capability subclass IIIe. It is in Sandy Prairie range site.

45—Nobscot fine sand, 2 to 5 percent slopes. This deep, well drained, very gently sloping and gently sloping soil is on undulating sandy uplands. Areas are irregular in shape and range from 10 to 200 acres.

Typically, the surface layer is brown fine sand about 9 inches thick. The subsurface layer is light brown fine sand to a depth of about 27 inches. The subsoil is reddish yellow fine sandy loam with lamellae of yellowish red sandy loam to a depth of about 40 inches, reddish yellow loamy fine sand with lamellae of reddish brown fine sandy loam to a depth of about 50 inches, and reddish yellow loamy fine sand to a depth of about 72 inches. The underlying material is reddish yellow fine sand to a depth of about 80 inches.

Natural fertility and organic matter content are low. The surface layer ranges from medium acid to neutral, and the subsoil is slightly acid to neutral. Permeability is moderately rapid, and runoff is very slow. The available water capacity is low. The surface layer is loose and easily tilled throughout a wide range of soil moisture. Root development is not restricted through all layers of the soil.

Included with this soil in mapping are a few areas of Devol and Grandfield soils. The included soils make up about 10 percent of mapped areas, but an individual area is less than 5 acres.

About 60 percent of the areas of this Nobscot soil is used for rangeland, and about 40 percent is used for cultivated crops. This soil has high potential for rangeland. If management is good, the production of native grasses is high.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, and other adapted grasses and legumes. Use of this soil for pasture or hayland is effective in helping to control wind erosion. Brush control is needed to prevent the invasion of shinnery oak. Overgrazing during dry periods causes the grass stand to die out. Proper stocking rates, rotation of grazing, and restricted use during dry periods help to keep the grasses and the soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has low potential for cultivated crops. It is suited to wheat, cotton, grain sorghum, and rye. Where this soil is used for cultivated crops, the hazard of wind erosion is severe and very intensive conservation measures are required. Minimum tillage, winter cover crops, field windbreaks, and keeping crop residue on the surface help to reduce wind erosion.

The potential is medium for use of trees as windbreaks. Low available water capacity is the main limitation. The potential is medium for producing habitat for openland wildlife and is high for producing habitat for rangeland wildlife.

This Nobscot soil has high potential for most building site developments and has low potential for most sanitary facilities. There is no significant limitation for septic tank absorption fields. Excessive seepage is the major limiting feature for sewage lagoons and sanitary landfills. Shallow excavations are limited by the sandy texture. Slope is a limitation for small commercial buildings.

The potential is low for most recreational uses. The sandy surface texture is the main limiting feature. Onsite investigation is necessary to properly evaluate and plan development of specified sites for all uses.

This soil is in capability subclass IVe. It is in Deep Sand Savannah range site.

46—Nobscot fine sand, 5 to 12 percent slopes. This deep, well drained, sloping to strongly sloping soil is on undulating to hummocky sandy uplands. Areas are irregular in shape and range from 10 to 300 acres.

Typically, the surface layer is brown fine sand about 7 inches thick. The subsurface layer is light yellowish brown fine sand to a depth of about 39 inches. The subsoil is yellowish red sandy loam with lamellae of red sandy clay loam to a depth of about 50 inches, yellowish red loamy fine sand with lamellae of red sandy loam to a depth of about 75 inches, and reddish yellow loamy fine sand to a depth of about 85 inches.

Natural fertility and organic matter content are low. The surface layer is medium acid to neutral, and the subsoil is slightly acid to neutral. Permeability is moderately rapid, and surface runoff is very slow. The available water capacity is low. The surface layer is loose and is easily tilled throughout a wide range of soil moisture. Root development is not restricted through all layers of the soil.

Included with this soil in mapping are a few small areas of Devol and Grandfield soils. The included soils make up about 10 percent of mapped areas, but an individual area is less than 5 acres.

About 80 percent of the areas of this Nobscot soil is used for rangeland and most of the remaining 20 percent is in tame pasture. This soil has high potential

for rangeland. If management is good, the production of native grasses is high.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, and other adapted grasses and legumes for hay and pasture. Use of this soil for pastureland or hayland is effective in helping to control wind erosion. Brush control is needed to prevent the invasion of shinnery oak. Overgrazing during dry periods causes the grass stand to die out. Proper stocking rates, restricted use during prolonged dry periods, timely deferment and rotation of grazing help to keep the grasses and the soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has low potential for cultivated crops. Where this soil is used for cultivated crops, the hazard of wind erosion is severe. Slope and wind erosion are the main limiting features. The potential is medium for use of trees as windbreaks. The main hazards and limitations for establishment of trees are wind erosion, slope, and insufficient soil moisture during summer. The potential is medium for producing habitat for openland wildlife and high for producing habitat for rangeland wildlife.

This Nobscot soil has medium potential for most building site developments and has low potential for sanitary facilities. Excessive seepage is the main limitation for sewage lagoons and sanitary landfills. Slope is the main limitation for septic tank absorption fields, dwellings, small commercial buildings, and roads and streets. The sandy texture is the main limitation for shallow excavations.

The potential is low for most recreational uses. The sandy surface texture is the main limitation. Onsite investigation is necessary to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass VIe. It is in Deep Sand Savannah range site.

47—Quanah-Talpa complex, 1 to 5 percent slopes. This complex consists of very gently sloping and gently sloping, well drained Quanah and Talpa soils on uplands. The Quanah soils are deep and are on foot slopes and broad, convex ridgetops. The Talpa soils are very shallow and shallow and are on convex ridgetops and side slopes. Individual areas of these soils are so intermingled or so small that to separate them at the scale selected for mapping was not practical. Most areas of this complex are in the northern part of the county. They are irregular in shape and range from 5 to 400 acres.

The Quanah soils make up about 50 percent of each mapped area. Typically, they have a surface layer of dark grayish brown silty clay loam about 14 inches thick. The subsoil is brown silty clay loam to a depth of about 36 inches. The underlying material is brown silty clay loam to a depth of about 80 inches.

Quanah soils are high in natural fertility and organic matter content. The pedon is moderately alkaline and calcareous throughout. Permeability is moderate, and surface runoff is medium. The available water capacity is high.

The Talpa soils make up about 20 percent of each mapped area. Typically, they have a surface layer of brown loam about 11 inches thick. The underlying material is hard, grayish dolomitic limestone.

Talpa soils are high in natural fertility and organic matter content. The pedon is moderately alkaline and calcareous throughout. Permeability is moderate, and surface runoff is medium. The available water capacity is very low.

Included with these soils in mapping are small areas of Aspermont soils on convex side slopes, Tillman soils on concave positions, and Cornick soils on ridges. Also included are small areas of outcrops of limestone. The included soils and outcrops make up about 30 percent of mapped areas, but an individual area is generally less than 5 acres.

Nearly all areas of this complex are used for rangeland. These soils have low to medium potential for rangeland and are better suited to rangeland than to most other uses. If management is good, the production of native grasses on Quanah soils is medium and on Talpa soils is low.

The potential for tame pasture and hayland is low because of the very low available water capacity and the restricted root zone of the Talpa soils. Overgrazing or grazing during prolonged dry periods is detrimental to grass stands and causes excessive runoff and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

The potential is low for cultivated crops. These soils are not suited to cultivated crops because of the shallow soils and the outcrops of rock.

This complex has low potential for use of trees as windbreaks. Low available water capacity and shallow depth to bedrock in areas of Talpa soils are the main limitations. The potential is low for producing habitat for openland wildlife and medium for producing habitat for rangeland wildlife.

The soils of this complex have medium potential for most building site developments and sanitary facilities. The moderate permeability of the Quanah soils is a concern for septic tank absorption fields but can be easily overcome by increasing the size of the absorption area. The Talpa soils are very shallow to shallow to bedrock, and this is a limitation that is very difficult to overcome for all uses. The deep Quanah soils are better suited to urban uses and sanitary facilities than are the shallow Talpa soils.

The potential is medium for most recreational uses. Slope and depth to rock are the main concerns. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This complex is in capability subclass VIs. The Quanah soils are in Hardland range site, and the Talpa soils are in Very Shallow range site.

48—Quinlan-Rock outcrop complex, 12 to 45 percent slopes. This complex consists of the shallow, well drained, moderately steep and steep Quinlan soils and Rock outcrop on convex uplands. The landscape consists of moderately steep and steep escarpments and canyons incised in the smoother uplands. The Quinlan soils are on ridgetops and escarpments, and the Rock outcrop is throughout mapped areas (fig. 11). Individual areas of Quinlan soils and Rock outcrop are so intermingled or so small that to separate them at the scale selected for mapping was not practical. Areas of this complex are mainly north of the Salt Fork of the Red River and its tributaries. They are irregular in shape and range from 25 to 500 acres.

The Quinlan soils make up about 50 percent of each mapped area. Typically, they have a surface layer of reddish brown very fine sandy loam about 5 inches thick. The subsoil is reddish brown very fine sandy loam to a depth of 10 inches. The underlying material is red, weakly cemented, calcareous sandstone to a depth of 40 inches or more.

Quinlan soils are low in natural fertility and organic matter content. The surface layer is mildly alkaline or moderately alkaline, and the subsoil is moderately alkaline. The pedon is typically calcareous throughout. Permeability is moderately rapid, and surface runoff is rapid. The available water capacity is very low. Root development is restricted below a depth of 20 inches by the sandstone. The shrink-swell potential is very low.

The Rock outcrop makes up about 25 percent of each mapped area. It consists of exposed, bare, soft gypsum bedrock on steep side slopes. Surface runoff is very rapid.

Included with this complex in mapping are small areas of Woodward soils on small ridges and upper side slopes, Yahola soils along narrow drainageways, and a deep soil in colluvial material on foot slopes. The included soils make up about 25 percent of mapped areas, but an individual area is generally less than 5 acres.

All areas of this complex are used for rangeland. The potential is low, but the soils are better suited to rangeland than most other uses. Steep slopes and shallowness to bedrock are the main limiting factors. If management is good, the production of native grasses is medium.

Areas of this complex are not suited to cultivated crops, tame pasture, or hayland. Soil depth, outcrops of rock, and slope are the main limitations. This complex is not suited to use of trees as windbreaks. Depth to bedrock, slope, very low to low available water capacity, and wind erosion are the main hazards and limitations to successful establishment and growth of trees. The potential is low for producing habitat for openland and rangeland wildlife.

This complex has low potential for most building site developments and sanitary facilities. Steep slopes are the main limitation for dwellings, small commercial buildings, local roads and streets, sewage lagoons, and shallow excavations. Depth to rock and slope are the main limitations for septic tank absorption fields and sanitary landfills.

The potential is low for most recreational developments. Slope and depth to bedrock are the main limitations. Onsite investigation is necessary to properly evaluate and plan the development of specified sites for all uses.

This complex is in capability subclass VIIe. The Quinlan soils are in Breaks range site, and Rock outcrop is not assigned to a range site.

49—Quinlan-Woodward complex, 3 to 5 percent slopes, eroded. This complex consists of gently sloping, well drained Quinlan and Woodward soils on eroded uplands. The Quinlan soils are shallow and are on narrow ridgetops and upper side slopes. The Woodward soils are moderately deep and are on broad ridgetops and lower side slopes. Individual areas of these soils are so intermingled or so small that to separate them at the scale selected for mapping was not practical. Rills and small gullies are common, and the subsoil is exposed in more than half of the areas. Areas of this complex are mainly in the northern part of the county. They are irregular in shape and range from 10 to 80 acres.

The Quinlan soils make up about 45 percent of each mapped area. Typically, they have a surface layer of red loam about 5 inches thick. The subsoil is red loam to a depth of about 17 inches. The underlying material is red, soft sandstone to a depth of about 60 inches.

Quinlan soils are medium in natural fertility and low in organic matter content. The pedon is moderately alkaline and calcareous throughout. Permeability is moderately rapid, and runoff is rapid. The available water capacity is low. The surface layer is friable and easily tilled throughout a wide range of soil moisture. Root development is restricted below a depth of about 17 inches by the sandstone bedrock.

The Woodward soils make up about 45 percent of each mapped area. Typically, they have a surface layer of red loam about 6 inches thick. The subsoil is red loam to a depth of about 29 inches. The underlying material is red, soft, weathered sandstone to a depth of about 60 inches.

Woodward soils are low in natural fertility and organic matter content. The pedon is mildly alkaline or moderately alkaline throughout. Permeability is moderate,

Figure 11.—An area of Quinlan-Rock outcrop complex, 12 to 45 percent slopes. Drainageway is deeply incised into soft sandstone and resistant gypsum layers. Quinlan soil in upper right background is in the Breaks range site.

and surface runoff is medium. The available water capacity is medium. The surface layer is friable and easy to till throughout a wide range of soil moisture. Root development is restricted below a depth of about 29 inches by the sandstone bedrock.

Included with this complex in mapping are small areas of Shrewder soils. The included soils make up about 10 percent of mapped areas, but an individual area is less than 3 acres.

Most areas of this complex are used for cultivated crops. The potential is low for this use. These soils are suited to wheat, cotton, and grain sorghum. Where cultivated crops are grown, the hazard of erosion is very severe. Minimum tillage, terraces, contour farming, cover crops, and residue management help to reduce soil loss. Returning crop residue to the surface helps to prevent crusting and erosion and helps to increase water infiltration.

The potential is medium for tame pasture and hayland. The soils are suited to bermudagrass, weeping lovegrass, and other adapted grasses and legumes. Using these soils for tame pasture or hayland is effective in helping to control erosion. Overgrazing or grazing the grass during prolonged dry periods is detrimental to the grass. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

Areas of this complex have medium potential for use as rangeland. If management is good, the production of native grasses on the Quinlan soils is medium and production of native grasses on the Woodward soils is high. The potential is low for use of trees as windbreaks. The main limitations are depth to bedrock and medium to low available water capacity. The potential is medium for producing habitat for openland and rangeland wildlife.

The soils in this complex have medium potential for most building site developments and have low potential for most sanitary facilities. Shallow depth to bedrock is the main limiting feature. It is a concern for sewage lagoons and is difficult to overcome. The moderately deep Woodward soils are better suited to most uses than Quinlan soils.

The potential is medium for most recreational uses. Slope and depth to bedrock are the main limiting

features. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This complex is in capability subclass IVe. The Quinlan soils are in Shallow Prairie range site, and the Woodward soils are in Loamy Prairie range site.

50—Salt flats. This map unit consists of areas along Elm Creek that are used as evaporating pits. These are manmade pits with a berm about 4 to 6 feet high. They are filled to a depth of about 2 feet with brine water pumped from salt springs. This water evaporates from the pit. The salt that is precipitated out on the floor of the pit is collected and sold for livestock salt. Some pits have been abandoned. They support sparse vegetation. Areas range from 5 to 15 acres.

This map unit is not assigned to a capability subclass or to a range site.

51—Shrewder fine sandy loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on convex slopes on uplands parallel to the Salt Fork of the Red River and some of its tributaries. Areas are irregular in shape and range from 10 to 60 acres.

Typically, the surface layer is reddish brown fine sandy loam about 16 inches thick. The subsoil is red loam to a depth of 49 inches. The underlying material is red very fine sandy loam to a depth of about 77 inches and is red, soft sandstone to a depth of about 80 inches.

Natural fertility and organic matter content are medium. The surface layer is slightly acid to mildly alkaline, and the subsoil is neutral or moderately alkaline. Permeability is moderately rapid, and surface runoff is slow. The available water capacity is medium. The surface layer is very friable and easily tilled throughout a wide range of soil moisture. This soil tends to crust after hard rains. Root development is not restricted.

Included with this soil in mapping are a few small areas of Woodward and Quinlan soils on convex knobs and Madge soils in depressions or concave positions. The included soils make up about 10 percent of mapped areas, but an individual area is less than 5 acres.

Most areas of this Shrewder soil are used for cultivated crops, and the potential is medium for this use. This soil is suited to cotton, wheat, and grain sorghum. Where this soil is used for cultivated crops, the hazards of wind and water erosion are moderate. Minimum tillage, winter cover crops, terracing and contour farming, and grassed waterways help to reduce erosion. Returning crop residue to the surface helps to improve fertility, reduce crusting, and increase water infiltration.

The potential is high for tame pasture and hayland. This soil is suited to alfalfa, bermudagrass, weeping lovegrass, and other adapted grasses and legumes. The use of this soil for pasture or hayland is effective in helping to control erosion. Overgrazing can cause surface compaction, excessive runoff and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during prolonged dry periods help to keep the pasture and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has high potential for use as rangeland. If management is good, the production of native grasses is high. The potential is high for use of trees as windbreaks. There are no serious limitations for trees on this soil. The potential is high for producing habitat for openland and rangeland wildlife.

This Shrewder soil has high potential for most building site developments and has medium potential for most sanitary facilities. Seepage is a concern for sewage lagoons and sanitary landfills. Excessive seepage from sewage lagoons can be prevented by special treatment to seal the bottom of the lagoon.

The potential is high for most recreational uses. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIIe. It is in Sandy Prairie range site.

52—Shrewder fine sandy loam, 3 to 5 percent slopes. This deep, well drained, gently sloping soil is on side slopes on uplands, generally along the Salt Fork of the Red River. Areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is reddish brown fine sandy loam about 11 inches thick. The subsoil is red very fine sandy loam to a depth of about 49 inches. The underlying material is red very fine sandy loam to a depth of about 62 inches and red, weakly cemented sandstone to a depth of about 72 inches.

Natural fertility and organic matter content are medium. The surface layer is neutral or mildly alkaline, and the subsoil is mildly alkaline or moderately alkaline. Permeability is moderately rapid, and surface runoff from cultivated areas is medium. The available water capacity is medium. The surface layer is friable and easily tilled throughout a wide range of soil moisture. Root development is not restricted to a depth of 62 inches or more.

Included with this soil in mapping are a few small areas of Woodward and Quinlan soils on convex slopes. The included soils make up about 10 percent of mapped areas, but an individual area is less than 5 acres.

Most areas of this Shrewder soil are used for cultivated crops, and the potential is medium for this use. This soil is suited to cotton, wheat, and grain sorghum. Where this soil is used for cultivated crops, the hazards of wind and water erosion are moderate. Minimum tillage, residue management, windbreaks, contour farming, and terracing help to prevent erosion. Leaving crop residue on the surface increases water infiltration and reduces runoff.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, and other adapted grasses and legumes. The use of this soil for pasture and hayland is effective in helping to control erosion. Overgrazing can cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment of grazing, and restricted use during dry periods help to keep the pasture and soil in good condition. Utilizing grasses that respond well to fertilization adds flexibility to the grazing system. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has high potential for rangeland. If management is good, the production of native grasses is high. The potential is high for use of trees as windbreaks. Insufficient soil moisture during part of the year is a limitation for trees. The potential is high for producing habitat for openland and rangeland wildlife.

This Shrewder soil has high potential for most building site developments and has medium potential for most sanitary facilities. Seepage is the main limitation for use as sewage lagoons and sanitary landfills. Excessive seepage from sewage lagoons can be prevented by special treatment to seal the bottom of the lagoon.

The potential is high for most recreational uses. Slope is a limitation for playgrounds. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIIe. It is in Sandy Prairie range site.

53—Spur clay loam, occasionally flooded. This deep, well drained, nearly level soil is on flood plains, mainly along Elm and Turkey Creeks, and their tributaries. The flood plains are subject to occasional flooding. Slope is 0 to 1 percent. Areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is brown clay loam about 11 inches thick. The subsoil is dark yellowish brown clay loam to a depth of about 27 inches and reddish brown clay loam to a depth of about 41 inches. The underlying material is reddish brown clay loam to a depth of about 80 inches.

Natural fertility and organic matter content are high. The pedon is moderately alkaline and calcareous throughout. Permeability is moderate, and surface runoff from cultivated areas is slow. The available water capacity is high. The surface layer is firm and easily tilled throughout a fairly wide range of soil moisture. It tends to crust or puddle after hard rains. The root zone is deep, and root development generally is not restricted. The shrink-swell potential is moderate.

Included with this soil in mapping are small areas of Mangum soils. The included soils make up about 10 percent of mapped areas, but an individual area is generally less than 3 acres.

Approximately half of the areas of this Spur soil is used for cultivated crops, and the rest is used for tame pasture. This soil has high potential for cultivated crops and is suited to wheat, alfalfa, grain sorghum, and cotton. Minimum tillage, winter cover crops, and return of crop residue help to improve fertility, reduce crusting, and increase water infiltration.

The potential is high for tame pasture and hayland. Bermudagrass, weeping lovegrass, alfalfa, and other adapted grasses and legumes are suitable for these uses. Overgrazing or grazing when the soil is too wet causes surface compaction, results in poor tilth, and reduces water infiltration. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during wet or prolonged dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has high potential for rangeland. If management is good, the production of native grasses is high. The potential is high for trees as windbreaks. Occasional flooding is the only concern to establishing trees. The high available water capacity helps to promote good growth of windbreak plantings. The potential is high for producing habitat for openland and rangeland wildlife.

This Spur soil has low potential for most building site developments and sanitary facilities. Flooding is the main concern.

The potential is low for most recreational uses. The main hazard is occasional flooding. Onsite investigation is necessary to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIw. It is in Loamy Bottomland range site.

54—Spur clay loam, frequently flooded. This deep, well drained, nearly level soil is on flood plains, mainly in the eastern part of the county. The flood plains are subject to frequent flooding. Slope is 0 to 1 percent. Areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is dark reddish gray clay loam about 18 inches thick. The subsoil is reddish brown clay loam to a depth of about 45 inches. The underlying material is light reddish brown clay loam to a depth of about 80 inches.

Natural fertility and organic matter content are high. The pedon is moderately alkaline and calcareous throughout. Permeability is moderate, and surface runoff is slow. The available water capacity is high. The root zone is deep, and root development generally is not restricted. The shrink-swell potential is moderate.

Included with this soil in mapping are a few small areas of Yahola, Clairemont, and Mangum soils. The included soils make up about 10 percent of mapped

areas, but an individual area generally is less than 3 acres.

This Spur soil has low potential for cultivated crops. Flooding is a hazard.

The potential is high for tame pasture and hayland. Bermudagrass, weeping lovegrass, alfalfa, and other adapted grasses and legumes are suitable for these uses. Overgrazing when the soil is too wet causes surface compaction, results in poor tilth, and reduces water infiltration. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during wet or prolonged dry periods keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has high potential for use as rangeland. If management is good, the production of native grasses is high. The potential is high for trees as windbreaks. Flooding can be a limitation in establishing trees. The potential is medium for producing habitat for rangeland wildlife and low for producing habitat for openland wildlife.

This Spur soil has low potential for most building site developments and sanitary facilities. Flooding is the main hazard.

The potential is low for most recreational uses. The frequent flooding is a hazard. Onsite investigation is necessary to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass Vw. It is in Loamy Bottomland range site.

55—Tillman clay loam, 0 to 1 percent slopes. This deep, well drained, nearly level soil is on broad flat uplands. Areas are irregular in shape and range from 20 to 320 acres.

Typically, the surface layer is reddish brown clay loam about 6 inches thick. The subsoil is reddish brown clay loam to a depth of about 12 inches, reddish brown clay to a depth of about 51 inches, and red clay and shaly clay to a depth of about 72 inches. The underlying material is red clay to a depth of 80 inches or more.

Natural fertility and organic matter content are high. The pedon is moderately alkaline. Permeability and surface runoff are slow. The available water capacity is high. The soil has fair tilth; it can be worked throughout a limited range of soil moisture. The root zone is deep, but roots are somewhat restricted by very firm clay layers below a depth of 20 inches. The shrink-swell potential is high.

Included with this soil in mapping are a few small areas of Hollister soils on small concave positions and Vernon soils on small convex positions. The included soils make up about 10 percent of mapped areas, but an individual area is generally less than 5 acres.

Nearly all areas of this Tillman soil are used for cultivated crops, and the potential is medium for this use. This soil is suited to wheat, cotton, and grain sorghum. The hazard of erosion is low. Minimum tillage, winter cover crops, terracing, grassed waterways, and residue management help to prevent soil losses, improve fertility, reduce surface crusting, and improve water infiltration.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass, alfalfa, weeping lovegrass, and other adapted grasses and legumes. Use of this soil for tame pasture or hayland is effective in helping to control erosion. Care must be taken to control stocking rates and time of grazing because grass stands are easily damaged during drought conditions. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has medium potential for use as rangeland. If management is good, the production of native grasses is medium. The potential is medium for trees as windbreaks. The dense clayey subsoil and the insufficient rainfall in summer are the main limitations to the successful establishment of trees. The potential is high for producing habitat for openland wildlife, and the potential is medium for producing habitat for rangeland wildlife.

This Tillman soil has low potential for most building site developments and has medium potential for most sanitary facilities. Shrink-swell potential is the main limitation for dwellings, small commercial buildings, and local roads and streets. This can be overcome by proper design and installation procedures. The slow permeability is a concern for septic tank absorption fields, but this can be overcome by increasing the size of the absorption field. Area type sanitary landfills and sewage lagoons have no significant limitations. The clayey texture is a limitation for trench type sanitary landfills and shallow excavations.

The potential is medium for most recreational uses. Erosion is the main limitation for paths and trails. Onsite investigation is necessary to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIs, nonirrigated, and in class I, irrigated. It is in Hardland range site.

56—Tillman clay loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on uplands. Slopes are smooth and convex. Areas are irregular in shape and range from 10 to 200 acres.

Typically, the surface layer is reddish brown and dark reddish brown clay loam about 12 inches thick. The subsoil is dark reddish gray clay to a depth of about 19 inches, reddish brown clay to a depth of about 51 inches, and yellowish red clay to a depth of about 62 inches. The underlying material is yellowish red clay to a depth of about 80 inches.

Natural fertility and organic matter content are high. The pedon is moderately alkaline. Permeability is slow, and surface runoff is medium. The available water capacity is high. The soil has fair tilth and can be worked

throughout a limited range of soil moisture. The root zone is deep, but roots are somewhat restricted by very firm clay layers below a depth of 20 inches. The shrink-swell potential is high.

Included with this soil in mapping are small areas of Hollister soils on small concave positions and Vernon soils on small convex positions. Included soils make up about 10 percent of mapped areas, but an individual area is generally less than 3 acres.

Most areas of this Tillman soil are used for cultivated crops. Some areas are used for range. This soil has medium potential for cultivated crops. It is suited to wheat, cotton, and grain sorghum. Where cultivated crops are grown, the hazard of erosion is moderate. Minimum tillage, winter cover crops, terracing, contour farming, grassed waterways, and residue management help to prevent soil loss, improve fertility, reduce surface crusting, and increase water infiltration.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, alfalfa, and other adapted grasses and legumes. Use of this soil for pasture or hayland is effective in helping to control erosion. Care must be taken to control stocking rates and time of grazing because grass stands are easily damaged during drought conditions. Fertilizing tame pasture grasses increases the amount of forage and improves the vigor of the plants.

The potential is medium for rangeland. If management is good, the production of native grasses is medium. The potential is medium for use of trees as windbreaks. The dense clayey subsoil and the insufficient rainfall in summer are the main limitations to successful establishment of trees. The potential is high for producing habitat for openland wildlife and medium for producing habitat for rangeland wildlife.

This Tillman soil has low potential for most building site developments and has medium potential for most sanitary facilities. Shrink-swell potential is the main limitation for dwellings, small commercial buildings, and local roads and streets. This can be overcome by proper design and installation procedures. The slow permeability is a concern for septic tank absorption fields, but this can be overcome by increasing the size of the absorption field. Area type sanitary landfills and sewage lagoons have no significant limitations. The clay texture is a limitation for trench type sanitary landfills and shallow excavations.

The potential is medium for most recreational uses. Erosion is a hazard, and slope is a limitation. Onsite investigation is necessary to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIIe, nonirrigated, and in capability subclass IIe, irrigated. It is in Hardland range site.

57—Tipton loam, 0 to 1 percent slopes. This deep, well drained, nearly level soil is on flat and slightly convex stream terraces. Areas are irregular in shape and range from 10 to 200 acres.

Typically, the surface layer is dark reddish gray loam about 9 inches thick. The subsoil is dark reddish brown loam to a depth of about 15 inches, dark reddish gray and reddish brown clay loam to a depth of about 38 inches, and reddish brown loam to a depth of about 52 inches. The underlying material is yellowish red loam to a depth of 80 inches or more.

Natural fertility and organic matter content are high. The surface layer and upper part of the subsoil are neutral or mildly alkaline, and the lower part of the subsoil is mildly alkaline or moderately alkaline. Permeability is moderate, and surface runoff is slow. The available water capacity is high. The surface layer is friable and easily tilled throughout a fairly wide range of soil moisture. It tends to crust or puddle after hard rains. Root development is not restricted throughout the soil. The shrink-swell potential is low.

Included with this soil in mapping are small areas of Altus soils on convex positions, Hardeman soils on small knolls, and Westview soils on slightly lower concave positions. The included soils make up about 5 percent of mapped areas, but an individual area is generally less than 3 acres.

Most areas of this Tipton soil are used for cultivated crops, and the potential is high for this use. This soil is suited to wheat, grain sorghum, and cotton. The hazard of wind erosion is moderate, and the hazard of water erosion is slight. Minimum tillage, winter cover crops, and residue management help to prevent soil loss, improve fertility, reduce surface crusting, and increase water infiltration.

The potential is high for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, alfalfa, and other adapted grasses and legumes. Use of this soil for tame pasture or hayland helps to control wind and water erosion. Overgrazing or grazing when the soil is too wet or too dry can cause compaction and restrict root development. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during wet or droughty conditions help keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the amount of forage and improves the vigor of the plants.

The potential is high for rangeland, although very few areas are used for this purpose. If management is good, the production of native grasses is high. The potential is high for use of trees as windbreaks. The potential is high for producing habitat for openland and rangeland wildlife.

This Tipton soil has high potential for most building site developments and has medium potential for most sanitary facilities. Seepage is a concern for sewage lagoons, but this can be overcome by special treatment to seal the bottom of the lagoon. The moderate permeability is a concern for septic tank absorption fields, but this can be overcome by enlarging the size of

the filter field. The loamy texture is a limitation for trench type sanitary landfills.

The potential is high for most recreational uses. Erosion is a hazard for paths and trails. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability class I, irrigated and nonirrigated. It is in Loamy Prairie range site.

58—Tipton loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on convex stream terraces. Major areas are adjacent to Lebos and Sandy Creeks. They are irregular in shape and range from 5 to 200 acres.

Typically, the surface layer is brown loam about 8 inches thick. The subsoil is brown loam to a depth of about 14 inches, reddish gray loam to a depth of about 23 inches, and reddish brown clay loam to a depth of about 59 inches. The underlying material is light reddish brown clay loam to a depth of about 80 inches.

Natural fertility and organic matter content are high. The upper part of the pedon is neutral or mildly alkaline, and the lower part is mildly alkaline or moderately alkaline. The lower part is calcareous. Permeability is moderate, and surface runoff is medium. The available water capacity is high. The surface layer is friable and easily tilled throughout a fairly wide range of soil moisture. It tends to crust after hard rains, especially in areas where the plow layer contains subsoil material. The root zone is deep, and penetration by plant roots is fairly easy. The shrink-swell potential is low.

Included with this soil in mapping are small areas of Grandfield and Hardeman soils on convex knolls and Westview soils on slightly lower positions. Also included are a few small areas of Altus soils. The included soils make up about 10 percent of mapped areas, but an individual area is less than 3 acres.

Most areas of this Tipton soil are used for cultivated crops, and the potential is high for this use. This soil is suited to wheat, grain sorghum, and cotton. The hazards of wind and water erosion are moderate. Minimum tillage, terracing, contour farming, grassed waterways, winter cover crops, and residue management help to reduce soil losses, improve fertility, reduce surface crusting, and increase water infiltration.

The potential is high for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, alfalfa, and other adapted grasses and legumes. Use of this soil for tame pasture or hayland helps to control wind and water erosion. Overgrazing or grazing when the soil is too wet or too dry can cause compaction and restrict root development. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during wet or droughty conditions help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has high potential for rangeland, although very few areas are used for this purpose. If management is good, the production of native grasses is high. The potential is high for use of trees as windbreaks. The potential is high for producing habitat for openland and rangeland wildlife.

This Tipton soil has high potential for most building site developments and has medium potential for most sanitary facilities. Seepage is a concern for sewage lagoons, but this can be overcome by special treatment to seal the bottom of the lagoon. Loamy texture is the main limitation for trench type sanitary landfills. Moderate permeability is a concern for septic tank absorption fields, but this can be overcome by enlarging the size of the absorption field.

The potential is high for most recreational uses. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIe, irrigated and nonirrigated. It is in Loamy Prairie range site.

59—Tivoli fine sand. This deep, excessively drained, sloping to moderately steep soil is in high dune areas adjacent to the Salt Fork of the Red River and Prairie Dog Town Fork of the Red River. Slopes are dominantly less than 12 percent but range from 8 to 20 percent. Areas are generally long and narrow and range from 10 to 150 acres.

Typically, the surface layer is brown fine sand about 13 inches thick. The underlying material is reddish yellow fine sand to a depth of about 80 inches.

Natural fertility and organic matter content are low. The upper part of the pedon is slightly acid to mildly alkaline, and the lower part is moderately alkaline. The pedon is typically calcareous at a depth of 13 to 40 inches. Permeability is rapid, and surface runoff is very slow. The available water capacity is low. The root zone is deep and easily penetrated by plant roots. The shrink-swell potential is low.

Included with this soil in mapping are a few small areas of Devol soils on gently sloping side slopes and Lincoln soils along small drainageways. The included soils make up about 10 percent of mapped areas, but an individual area is less than 5 acres.

All areas of this Tivoli soil are used for rangeland. Although the soil has low potential for rangeland, it is better suited to rangeland than to other uses. If management is good, the production of native grasses is low. Using this soil as rangeland helps to control wind erosion. Very careful management is required to maintain an adequate plant cover.

The potential is low for cultivated crops, tame pasture, or hayland. The hazard of wind erosion is very severe. In addition, steepness of slope and low available water capacity are limitations for these uses. This soil is not suited to the use of trees as windbreaks. Steepness of slope and low available water capacity are the main

limitations. The potential is low for producing habitat for openland and rangeland wildlife.

This Tivoli soil has low potential for most building site developments and sanitary facilities. Seepage is the main limitation for sewage lagoons and sanitary landfills. Slope is the main limitation for septic tank absorption fields, dwellings, small commercial buildings, and local roads and streets.

The potential is low for most recreational uses. Slope and the sandy surface layer are the main limitations. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass VIIe. It is in Dune range site.

60—Likes-Devol complex, 3 to 12 percent slopes, gullied. This complex consists of gently sloping to strongly sloping, excessive drained and well drained, deep soils on sandy uplands. The Likes soils are on convex upper side slopes and ridgetops of narrow finger ridges. The Devol soils are on long convex side slopes. These soils have been used for cultivated crops or they have received surface runoff from adjoining cropland, and very severe wind and water erosion has removed the topsoil from more than 50 percent of the areas. Numerous crossable and uncrossable gullies have formed where water is concentrated in old broken terraces and in narrow drainageways. Individual areas of these soils are so intermingled or so small that to separate them at the scale selected for mapping was not practical. Areas of this complex are irregular in shape and range from 10 to 70 acres.

The Likes soils make up about 50 percent of each mapped area. Typically, they have a surface layer of reddish brown gravelly loamy fine sand about 11 inches thick. The underlying material is reddish yellow gravelly loamy fine sand to a depth of about 80 inches.

Likes soils are low in natural fertility and organic matter content. They are moderately alkaline and calcareous throughout. Permeability is rapid, and surface runoff is slow. The available water capacity is low. The root zone is deep, and root penetration is not restricted.

The Devol soils make up about 25 percent of each mapped area. Typically, they have a surface layer of reddish brown loamy fine sand about 6 inches thick. The subsoil is reddish brown fine sandy loam to a depth of about 24 inches and yellowish red loamy fine sand to a depth of about 36 inches. The underlying material is yellowish red loamy fine sand to a depth of about 80 inches.

Devol soils are low in natural fertility and organic matter content. The surface layer is slightly acid to mildly alkaline, the subsoil is neutral or mildly alkaline, and the underlying material is neutral to moderately alkaline. Permeability is moderately rapid, and surface runoff is slow. The available water capacity is medium. The root zone is deep, and roots are not restricted to a depth of 80 inches or more.

Included with these soils in mapping are small areas of Hardeman soils on lower side slopes and foot slopes and Grandfield soils on narrow ridgetops. Also included are a few small areas of exposed red-bed material. The included soils make up about 25 percent of mapped areas, but an individual area is less than 3 acres.

Most areas of this complex are old cultivated fields that have been reseeded to grass or left idle. In areas where the subsoil is exposed, vegetation is sparse and surface runoff is rapid. Potential is low for tame pasture and hayland, but these are the best treatments for reclamation. Strong slopes and severe erosion are the main limiting features. Gully shaping and smoothing is needed in some areas to seed and establish grasses. These soils are suited to bermudagrass, weeping lovegrass, and other adapted grasses and legumes. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during dry periods, help to keep the grasses and the soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

The soils in this complex have low potential for cultivated crops. Strong slopes and the severe hazard of erosion are the main limiting features.

These soils have medium potential for rangeland. If management is good, the production of native grasses is medium. The potential is low for use of trees as windbreaks. The growth is limited because of the strong slopes and the insufficient soil moisture during the growing season. The potential is low for producing habitat for openland and rangeland wildlife.

The soils in this complex have medium potential for building site developments and have low potential for sanitary facilities. Seepage is the main limitation for sewage lagoons and sanitary landfills. Strong slopes are the main limitations for septic tank absorption fields, dwellings, small commercial buildings, and roads and streets.

The potential is low for most recreational uses. Strong slopes are the main limitations for playgrounds, camp areas, and picnic areas. Paths and trails have no significant limitations. Onsite investigation is essential to properly evaluate and plan the development of specified sites.

This complex is in capability subclass VIe. It is in Eroded Sandyland range site.

61—Ustorthents, sandy. This map unit consists of areas in which part of the soil and underlying material have been removed for building roads, dams, foundations, and other structures. In these areas, excavations, such as borrow pits, gravel pits, and sand pits, have nearly vertical sides and very gently sloping to sloping bottoms. They range from 5 to 30 feet in depth, 300 to 1,500 feet in length, and 150 to 1,000 feet in

width. The soil material in these areas is quite variable in texture and content of coarse fragments.

Most areas of this map unit are revegetating naturally and support a sparse cover of annual weeds and grasses. The potential is low for rangeland, but most areas are better suited to rangeland than to other uses. If management is good, low to moderate amounts of native grasses can be grown. Good management includes seeding adapted species, deferment of grazing, proper stocking rates, and rotation of grazing.

The potential is low for most building site developments, sanitary facilities, and recreational uses.

This map unit is not assigned to a capability subclass or to a range site.

62—Vernon clay loam, 1 to 3 percent slopes. This moderately deep, well drained, very gently sloping soil is on broad, convex uplands. Areas are irregular in shape and range from 10 to 400 acres.

Typically, the surface layer is reddish brown clay loam about 7 inches thick. The subsoil is reddish brown clay to a depth of about 20 inches and red clay to a depth of about 34 inches. The underlying material is red, weakly consolidated shale with thin strata of blue gray shale to a depth of about 60 inches.

Natural fertility and organic matter content are low. The pedon is moderately alkaline and calcareous. Permeability is very slow, and runoff is rapid. The available water capacity is low or medium. The surface layer is firm and can be tilled only in a narrow range of soil moisture. Root development is restricted below a depth of about 34 inches.

Included with this soil in mapping are a few small areas of Tillman soils in concave positions and Knoco soils on convex knolls and ridgetops. The included soils make up about 15 percent of mapped areas, but an individual area is generally less than 5 acres.

Most areas of this Vernon soil are used for cultivated crops, and the potential is medium for this use. This soil is suited to wheat and grain sorghum. The hazard of water erosion is moderate. Terracing, contour farming, and crop residue management help to prevent erosion, increase water infiltration rate, and maintain tilth.

The potential is low for tame pasture and hayland. The low available water capacity and the low water infiltration are the main limitations for improved grasses and legumes. Proper stocking rates, rotation of grazing, and restricted use during dry periods help to keep the soil and grasses in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has low potential for rangeland. If management is good, the production of native grasses is low. The potential is low for use of trees as windbreaks. High clay content, insufficient soil moisture during part of the year, and depth to bedrock are the main limiting features. The potential is medium for producing habitat for openland and rangeland wildlife.

This Vernon soil has low potential for most building site developments and sanitary facilities. The very slow permeability is a limitation for septic tank absorption fields, and the shrink-swell is a limitation for dwellings. These limitations can be overcome by proper design and careful installation. The potential is low for sewage lagoons because of depth to bedrock.

The potential is low for most recreational uses. The very slow permeability is the main limiting feature. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIIe, irrigated and nonirrigated. It is in Red Clay Prairie range site.

63—Vernon clay loam, 3 to 5 percent slopes. This moderately deep, well drained, gently sloping soil is on broad, convex uplands. Areas are irregular in shape and range from 5 to 40 acres.

Typically, the surface layer is reddish brown clay loam about 7 inches thick. The subsoil is reddish brown clay to a depth of about 33 inches and red clay to a depth of about 38 inches. The underlying material is red shale with thin strata of olive gray, clayey shale to a depth of about 80 inches.

Natural fertility and organic matter content are low. The pedon is moderately alkaline and calcareous. Permeability is very slow, and runoff is rapid. The available water capacity is low or medium. The surface layer is firm and can be tilled only in a narrow range of soil moisture. Root development is restricted below a depth of about 38 inches.

Included with this soil in mapping are a few small areas of Tillman soils in concave positions and Knoco soils on convex knolls and ridges. The included soils make up about 15 percent of mapped areas, but an individual area is generally less than 5 acres.

Most areas of this Vernon soil are used for cultivated crops, and the potential is medium for this use. This soil is suited to wheat and grain sorghum. The hazard of water erosion is severe. Terracing, contour farming, grassed waterways, and crop residue management help to control erosion, increase water infiltration rate, and maintain tilth.

The potential is low for tame pasture and hayland. Low available water capacity and low water infiltration are the major limitations for improved grasses and legumes. The use of this soil for tame pasture or hayland is effective in helping to control erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during prolonged dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has low potential for use as rangeland. If management is good, the production of native grasses is low. The potential is low for use of trees as windbreaks. Limiting features are the high clay content, low available moisture capacity, low water infiltration rate, and depth to bedrock. The potential is medium for producing habitat for openland and rangeland wildlife.

This Vernon soil has low potential for most building site developments and sanitary facilities. The very slow permeability is a limitation for septic absorption fields, and the shrink-swell potential is a limitation for dwellings. These limitations can be overcome by proper design and careful installation. Depth to rock is the main limitation for sewage lagoons.

The potential is low for most recreational uses. The very slow permeability is the main limiting feature. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IVe, irrigated and nonirrigated. It is in Red Clay Prairie range site.

64—Vernon clay loam, 2 to 5 percent slopes, eroded. This moderately deep, well drained, very gently sloping and gently sloping soil is on uplands associated with minor drainageways. Because of erosion, most of the topsoil has been removed, the subsoil has been exposed in about 70 percent of the areas, and small rills and gullies have formed. Areas are irregular in shape and range from 10 to 40 acres.

Typically, the surface layer is reddish brown clay loam about 8 inches thick. The subsoil is red clay to a depth of about 21 inches. The underlying material is red, weathered shale interbedded with olive siltstone and shale to a depth of about 80 inches.

Natural fertility and organic matter content are low. The pedon is moderately alkaline and typically calcareous throughout. Permeability is very slow, and runoff is rapid. The available water capacity is low or medium. The surface layer is firm and can be tilled only in a narrow range of soil moisture. Root development is restricted below a depth of about 21 inches.

Included with this soil in mapping are small areas of Knoco soils on convex knolls and side slopes and Tillman soils on concave positions. The included soils make up about 20 percent of mapped areas, but an individual area is generally less than 5 acres.

Most areas of this Vernon soil are used for cultivated crops, and the potential is low for this use. This soil is suited to wheat and grain sorghum. The hazard of water erosion is severe. Terracing, contour farming, grassed waterways, and crop residue management help to reduce erosion, increase the water infiltration rate, and maintain tilth.

The potential is low for tame pasture and hayland. Low available water capacity and low water infiltration are the main limitations for improved grasses and legumes. The use of this soil for tame pasture or hayland is effective in helping to control erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases production of forage and improves the vigor of the plants.

This soil has low potential for rangeland. If management is good, the production of native grasses is low; this use, however, helps to control erosion and maintain soil structure. The potential is low for use of trees as windbreaks. Limiting factors are high clay content, insufficient soil moisture during part of the year, and depth to bedrock. The potential is medium for producing habitat for openland and rangeland wildlife.

This Vernon soil has low potential for most building site developments and sanitary facilities. Very slow permeability is a limitation for septic absorption fields, and shrink-swell potential is a limitation for dwellings and small commercial buildings. These limitations can be overcome by proper design and careful installation procedures. Depth to rock is the main limitation for sewage lagoons and sanitary landfills.

The potential is low for most recreational uses. The very slow permeability is the main limiting feature. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IVe, irrigated and nonirrigated. It is in Red Clay Prairie range site.

65—Vernon-Knoco complex, 1 to 12 percent slopes. This complex consists of very gently sloping to strongly sloping, well drained to excessive drained soils on broad, convex ridges and side slopes on uplands. The Vernon soils are moderately deep and on the flat ridge crests and shoulder slopes. The Knoco soils are very shallow and on the side slopes and toe slopes. Individual areas of these soils are 200 to 1,500 feet wide and so intermingled that to separate them at the scale selected for mapping was not practical. Areas are irregular in shape and range from 10 to 200 acres.

The Vernon soils make up about 50 percent of each mapped area. Typically, they have a surface layer of reddish brown clay loam about 4 inches thick. The subsoil to a depth of about 24 inches is reddish brown clay. The underlying material is interbedded red and gray shale to a depth of about 80 inches.

Vernon soils are low in natural fertility and organic matter content. The pedon is moderately alkaline and calcareous throughout. Permeability is very slow, and surface runoff is rapid. The available water capacity is low to medium. Root development is restricted below a depth of about 24 inches.

The Knoco soils make up about 20 percent of each mapped area. Typically, they have a surface layer of red clay about 8 inches thick. The underlying material is red and gray shale and clay to a depth of about 80 inches.

Knoco soils are low in natural fertility and organic matter content. The pedon is moderately alkaline and calcareous throughout. Permeability is very slow, and surface runoff is rapid. The available water capacity is very low. Root development is restricted below a depth of about 8 inches.

Included with these soils in mapping are small areas of Tillman soils on narrow ridges and depressional positions. Also included are small areas of Cornick soils. Outcrops of gypsum are scattered throughout mapped areas. The included soils and outcrops make up about 30 percent of each mapped area, but an individual area is less than 5 acres.

The potential is low for the use of this complex for cultivated crops, tame pasture, and hayland. Soil depth and strong slopes are the limiting features.

Most areas of this complex are used for rangeland. The potential is low for native grasses. Clayey texture and depth to bedrock are the main limitations. If management is good, the production of native grasses is medium.

This complex has low potential for trees as windbreaks. Depth to bedrock, very low or low available water capacity, and strong slopes are the main limitations. The potential is medium or low for producing habitat for openland wildlife and rangeland wildlife.

Areas of this complex have low potential for most building site developments and sanitary facilities. High shrink-swell potential and strong slopes are the main limitations for dwellings, small commercial buildings, and local roads and streets. The very slow permeability of both soils and the very shallow depth to bedrock of Knoco soils are the main limitations for septic tank absorption fields. Clayey texture and depth to bedrock are the main limitations for shallow excavations. The very shallow depth to bedrock of Knoco soils and the clayey texture of Vernon soils are the main limitations for trench type sanitary landfills. Depth to rock is the main limitation for area type sanitary landfills.

The potential is low for most recreational uses. Very slow permeability, depth to rock, and strong slopes are limitations for camp areas and picnic areas. Clayey texture, depth to rock, and strong slopes are the main limitations for playgrounds. Erosion of the clayey surface layer is the main limitation for paths and trails. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This complex is in capability subclass VIe. It is in Red Clay Prairie range site.

66—Westview silty clay loam, 0 to 1 percent slopes. This deep, well drained, nearly level soil is on broad, smooth or concave stream terraces. Areas are irregular in shape and range from 30 to 300 acres.

Typically, the surface layer is reddish brown silty clay loam about 6 inches thick. The subsoil is reddish brown silty clay loam to a depth of about 36 inches and light reddish brown silty clay loam to a depth of about 50 inches. The underlying material is reddish brown silty clay loam to a depth of about 80 inches.

Natural fertility and organic matter content are high. The surface layer and upper part of the subsoil are neutral to moderately alkaline. The lower part of the subsoil is mildly alkaline or moderately alkaline and is calcareous. Permeability is moderately slow, and surface runoff is slow. The available water capacity is high. The surface layer has fair tilth and can be worked only in a limited range of soil moisture. The root zone is deep, and its penetration by plant roots is fairly easy.

Included with this soil in mapping are small areas of Tipton soils on convex positions. The included soils make up about 5 percent of mapped areas, but an individual area is generally less than 5 acres.

Most areas of this Westview soil are used for cultivated crops. This soil has high potential for cultivated crops and is suited to wheat, cotton, and grain sorghum. Where this soil is used for cultivated crops, the hazards of wind and water erosion are slight. Minimum tillage, winter cover crops, and residue management help to prevent soil loss, improve fertility, and increase water infiltration.

The potential is high for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, alfalfa, and other adapted grasses and legumes. Overgrazing during dry periods can cause the grass stand to die out. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has high potential for use as rangeland, although very few areas are used for this purpose. If management is good, the production of native grasses is medium. The potential is high for use of trees as windbreaks. The potential is high for producing habitat for openland wildlife and is medium for producing habitat for rangeland wildlife.

This Westview soil has medium potential for most building site developments and sanitary facilities. Shrink-swell potential is the main limitation for buildings and local roads and streets, but this can be overcome by proper construction. Moderately slow permeability is the main limitation for septic tank absorption fields, but this can be overcome by enlarging the absorption field.

The potential is high for most recreational uses. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIc, nonirrigated, and in capability class I, irrigated. It is in Loamy Prairie range site.

67—Woodward loam, 1 to 3 percent slopes. This moderately deep, well drained, very gently sloping soil is

on broad, convex slopes on uplands. Areas are irregular in shape and range from 5 to 200 acres.

Typically, the surface layer is yellowish red and reddish brown loam about 15 inches thick. The subsoil is red loam to a depth of about 32 inches and red very fine sandy loam to a depth of about 38 inches. The underlying material is red, soft, weakly cemented, calcareous sandstone to a depth of about 60 inches.

Natural fertility and organic matter content are medium. The surface layer ranges from neutral to moderately alkaline, and the subsoil is mildly alkaline to moderately alkaline. Permeability is moderate, and surface runoff is medium. The available water capacity is medium. The surface layer is friable and easily tilled throughout a wide range of soil moisture. It tends to crust or puddle after hard rains. Root development is restricted below a depth of about 38 inches by soft sandstone.

Included with this soil in mapping are a few small areas of Quinlan soils on small knolls and on rims of convex positions and Carey soils on narrow, flat ridgetops and concave positions. The included soils make up about 10 percent of mapped areas, but an individual area is generally less than 5 acres.

Most areas of this Woodward soil are used for cultivated crops. This soil has medium potential for cultivated crops and is suited to cotton, wheat, and grain sorghum. Where this soil is used for cultivated crops, the hazards of wind and water erosion are moderate. Minimum tillage, winter cover crops, terracing, contour farming, windbreaks, and grassed waterways help to prevent excessive soil loss. Returning crop residue to the soil helps to maintain or improve fertility, reduce crusting, and increase water infiltration.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, and other adapted grasses and legumes. The use of the soil for tame pasture or hayland effectively helps to control erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during long, dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has high potential for use as rangeland, although few areas are used for this purpose. If management is good, the production of native grasses is high. The potential is medium for use of trees as windbreaks. Insufficient soil moisture during dry periods and depth to bedrock are the main limitations. The potential is high for producing habitat for openland wildlife and is medium for producing habitat for rangeland wildlife.

This Woodward soil has medium potential for most building site developments and has low potential for most sanitary facilities. The depth to rock is a limitation for septic tank absorption fields, shallow excavations, and trench type sanitary landfills. It is also a limitation for sewage lagoons and dwellings with basements.

The potential is high for most recreational uses. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIe, irrigated and nonirrigated. It is in Loamy Prairie range site.

68—Woodward loam, 3 to 5 percent slopes. This moderately deep, well drained, gently sloping soil is on uplands. It mainly is on convex side slopes and the side slopes of drainageways. Areas are irregular in shape and range from 5 to 75 acres.

Typically, the surface layer is reddish brown loam about 7 inches thick. The subsoil to a depth of 28 inches is red loam. The underlying material is red, weakly cemented, calcareous sandstone to a depth of about 60 inches.

Natural fertility and organic matter content are medium. The surface layer ranges from neutral to moderately alkaline, and the subsoil is mildly alkaline or moderately alkaline. Permeability is moderate, and surface runoff is medium. The available water capacity is medium. The surface layer is friable and easily tilled throughout a wide range of soil moisture. Root development is restricted by sandstone at a depth of about 36 inches.

Included with this soil in mapping are a few small areas of Quinlan soils on shoulder slopes and small knolls and Shrewder soils on foot slopes. The included soils make up about 10 percent of mapped areas, but an individual area is generally less than 5 acres.

Most areas of this Woodward soil are used for cultivated crops. The soil has medium potential for this use and is suited to wheat, grain sorghum, and cotton. In areas of cultivated crops, the hazards of wind and water erosion are moderate. Terraces, contour farming, residue management, windbreaks, and grassed waterways help to reduce runoff and control erosion.

The potential is medium for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, and other adapted grasses and legumes. Use of this soil for tame pasture or hayland effectively helps to control erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during dry periods help to keep the grasses and the soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has high potential for use as rangeland. If management is good, the production of native grasses is high. The potential is medium for trees as windbreaks. Insufficient soil moisture and depth to bedrock are the main limitations. The potential is high for producing

habitat for openland wildlife and is medium for producing habitat for rangeland wildlife.

This Woodward soil has medium potential for most building site developments and low potential for most sanitary facilities. Depth to bedrock limits the use of this soil for sanitary facilities, such as septic tank absorption fields, sewage lagoons, and trench type sanitary landfills. It also limits the use of this soil for dwellings with basements.

The potential is high for most recreational uses. Slope is the limiting feature for playgrounds. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIIe. It is in Loamy Prairie range site.

69—Woodward-Quinlan complex, 1 to 3 percent slopes. This complex consists of well drained, very gently sloping soils on convex uplands, mainly in the northern part of the county. The Woodward soils are moderately deep, and the Quinlan soils are shallow. These soils are on broad ridgetops and side slopes. Individual areas of these soils are so intermingled or so small that to separate them at the scale selected for mapping was not practical. Areas are irregular in shape and range from 5 to 100 acres.

The Woodward soils make up about 50 percent of each mapped area. Typically, they have a surface layer of reddish brown loam about 9 inches thick. The subsoil is red loam to a depth of 35 inches. The underlying material is red, weakly cemented, calcareous sandstone to a depth of 60 inches.

Woodward soils are medium in natural fertility and organic matter content. The pedon is mildly alkaline or moderately alkaline and typically calcareous throughout. Permeability is moderate, and surface runoff is medium. The available water capacity is medium. The rooting zone is moderately deep and is easily penetrated by plant roots.

The Quinlan soils make up about 40 percent of each mapped area. Typically, they have a surface layer of reddish brown loam about 6 inches thick. The subsoil is red loam to a depth of about 14 inches. The underlying material is red, weakly cemented, calcareous sandstone to a depth of about 40 inches.

Quinlan soils are medium in natural fertility and organic matter content. The pedon is mildly alkaline or moderately alkaline and is generally calcareous throughout. Permeability is moderate to moderately rapid, and surface runoff is medium. The available water capacity is low.

Included with these soils in mapping are small areas of Carey soils. The included soils make up about 10 percent of mapped areas, but an individual area is generally less than 5 acres.

Most areas of this complex are used for cultivated crops, and the potential is medium for this use. The depth to sandstone and the moderate hazard of erosion are the main concerns. The soils in this complex are suited to cotton, wheat, and grain sorghum. The hazards of wind and water erosion are moderate. Minimum tillage, terraces, contour farming, grassed waterways, windbreaks, and winter cover crops help to reduce runoff and erosion. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, reduce soil erosion, and increase water infiltration.

The potential is medium for tame pasture and hayland. The soils are suited to bermudagrass, weeping lovegrass, and other adapted grasses and legumes. The use of the soils for tame pasture or hayland effectively helps to control erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during long, dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases production and improves the vigor of the plants.

This complex has medium potential for rangeland. If management is good, the production of native grasses on Woodward soils is high and on Quinlan soils is medium.

This complex has medium potential for trees as windbreaks. The main limitations are low or medium available water capacity and depth to bedrock. The potential is medium for producing habitat for openland and rangeland wildlife.

Areas of this complex have medium potential for most building site developments and sanitary facilities. Depth to bedrock is the main limitation for dwellings, small commercial buildings, and local roads and streets. Depth to bedrock is a limitation for septic tank absorption fields and other sanitary facilities. The moderately deep Woodward soils are better suited to urban uses than the shallow Quinlan soils.

The potential is medium for most recreational uses. Depth to bedrock and slopes are the main limitations for playgrounds. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This complex is in capability subclass IIIe. The Woodward soils are in Loamy Prairie range site and the Quinlan soils are in Shallow Prairie range site.

70—Woodward-Quinlan complex, 3 to 5 percent slopes. This complex consists of well drained, gently sloping Woodward and Quinlan soils on side slopes and along drainageways of convex uplands. The Woodward soils are moderately deep, and the Quinlan soils are shallow. Individual areas of these soils are 100 to 500 feet wide and are so intermingled that to separate them at the scale selected for mapping was not practical. Areas of this complex are irregular in shape and range from 10 to 200 acres.

The Woodward soils make up about 50 percent of each mapped area. Typically, they have a surface layer of reddish brown loam about 6 inches thick. The subsoil is red and reddish brown loam to a depth of about 25 inches. The underlying material is red, weakly cemented, calcareous sandstone to a depth of about 60 inches.

Woodward soils are medium in natural fertility and organic matter content. The pedon is moderately alkaline. Typically, it is calcareous throughout, but in some areas it is noncalcareous. Permeability is moderate, and surface runoff is medium. The available water capacity is medium. The rooting zone is moderately deep and is easily penetrated by plant roots.

The Quinlan soils make up about 47 percent of each mapped area. Typically, they have a surface layer of reddish brown loam about 6 inches thick. The subsoil is red loam to a depth of about 13 inches. The underlying material is red, weakly cemented, calcareous sandstone to a depth of about 40 inches.

Quinlan soils are low in natural fertility and organic matter content. The pedon is moderately alkaline. Typically, it is calcareous throughout, but in some areas it may be noncalcareous. Permeability is moderate to moderately rapid, and surface runoff is medium. The available water capacity is low. The rooting zone is shallow but is easily penetrated by plant roots. Soft sandstone restricts root development below a depth of 20 inches.

Included with these soils in mapping are a few small areas of Shrewder soils. The included soils make up about 3 percent of mapped areas, but an individual area is generally less than 3 acres.

The soils in this complex have low potential for cultivated crops. Shallow depth to bedrock and slopes are the main limitations. These soils are suited to cotton, wheat, and grain sorghum. In cultivated areas, the hazards of wind and water erosion are moderate. Minimum tillage, contour farming, terracing, windbreaks, and grassed waterways help to control erosion. Residue management helps to control erosion, improve tilth and fertility, and increase water infiltration.

The potential is medium for tame pasture and hayland. The soils are suited to bermudagrass, weeping lovegrass (fig. 12), and other adapted grasses and legumes. Using these soils for tame pasture or hayland effectively helps to control erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during long, dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases production and improves the vigor of the plants.

This complex has high to medium potential for use as rangeland. If management is good, the production of native grasses on Woodward soils is high and on Quinlan soils is medium. The potential is medium for use of trees as windbreaks. The main limitations are depth to bedrock and low available water capacity. The potential is high for producing habitat for openland wildlife and medium for rangeland wildlife.

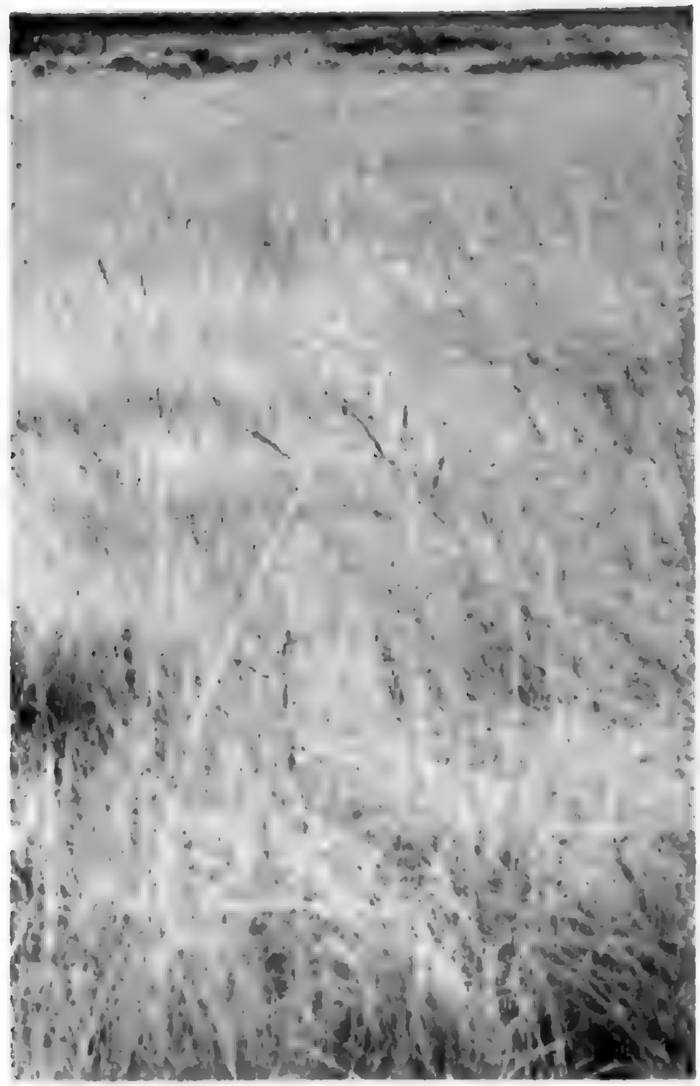


Figure 12.—Weeping lovegrass in an area of Woodward-Quinlan complex, 3 to 5 percent slopes.

Areas of this complex have medium potential for most building site developments and sanitary facilities. Depth to bedrock is the main limitation for dwellings, small commercial buildings, and local roads and streets. Depth to bedrock is a limitation for septic tank absorption fields and sewage lagoons. The moderately deep Woodward soils are better suited to these uses than the shallow Quinlan soils.

The potential is high for most recreational uses. Depth to rock and slope are the main limitations for playgrounds. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This complex is in capability subclass IVe. The Woodward soils are in Loamy Prairie range site, and the Quinlan soils are in Shallow Prairie range site.

71—Woodward-Quinlan complex, 5 to 12 percent slopes. This complex consists of well drained, sloping to strongly sloping Woodward and Quinlan soils on convex uplands. These soils are mainly along drainageways north of the Salt Fork of the Red River. The Woodward soils are moderately deep and are on ridgetops and foot slopes. The Quinlan soils are shallow and are on convex side slopes and small escarpments. Individual areas of these soils are so intermingled or so small that to separate them at the scale selected for mapping was not practical. Areas are irregular in shape and range from 10 to 500 acres.

The Woodward soils make up about 55 percent of each mapped area. Typically, they have a surface layer of reddish brown loam about 9 inches thick. The subsoil is yellowish red loam to a depth of about 21 inches and red loam to a depth of about 26 inches. The underlying material is red, weakly cemented sandstone to a depth of about 40 inches (fig. 13).

Woodward soils are medium in natural fertility and organic matter content. The surface layer is neutral to moderately alkaline, and the subsoil is mildly alkaline or moderately alkaline. Typically, the pedon is calcareous throughout. Permeability is moderate, and surface runoff is rapid. The available water capacity is medium. The root zone is moderately deep, and root penetration is restricted because of sandstone.

The Quinlan soils make up about 35 percent of each mapped area. Typically, they have a surface layer of reddish brown loam about 4 inches thick. The subsoil is red loam to a depth of about 12 inches. The underlying material is red, weakly consolidated sandstone to a depth of about 20 inches.

Quinlan soils are low in natural fertility and organic matter content. The pedon is moderately alkaline. Typically, it is calcareous throughout, but in some areas it is noncalcareous. Permeability is moderate to moderately rapid, and surface runoff is rapid. The available water capacity is low. The root zone is shallow but is easily penetrated by plant roots. Soft sandstone restricts root development below a depth of 20 inches.

Included with these soils in mapping are a few small areas of Shrewder soils on convex to concave foot slopes and narrow ridges and small areas of outcrops of gypsum. The included soils and outcrops make up about 10 percent of mapped areas, but an individual area is generally less than 5 acres.

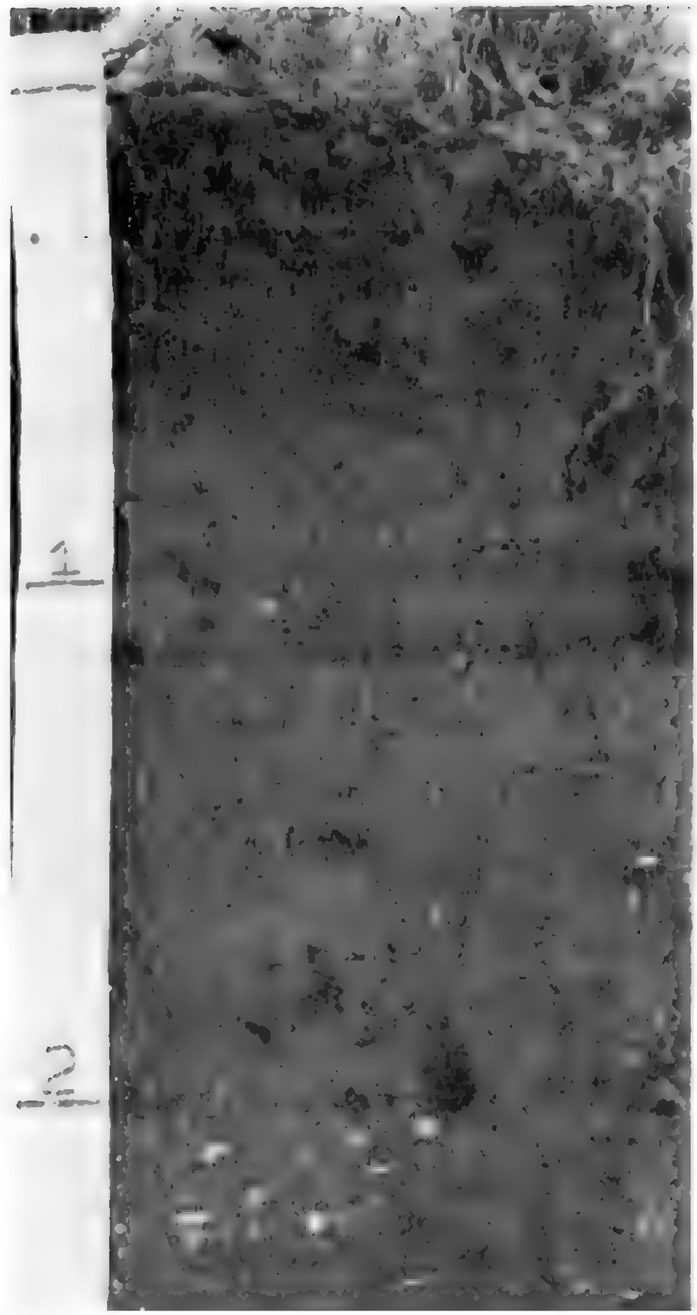


Figure 13.—Profile of Woodward loam, showing soft weakly cemented sandstone with pockets of blue-gray impurities in sandstone at a depth of 26 inches. Scale is in feet.

Most areas of this complex are used for rangeland, and the potential is medium for this use. If management is good, the production of native grasses on Woodward soils is high and on Quinlan soils is medium.

Figure 14.—An area of Woodward-Quinlan complex, 5 to 12 percent slopes. The Woodward soil is in Loamy Prairie range site, and the Quinlan soil is in Shallow Prairie range site.

This complex has low potential for tame pasture and hayland. The soils are suited to bermudagrass, weeping lovegrass, and other adapted grasses and legumes. Use of this complex as pastureland is effective in helping to control erosion. Proper stocking rates, timely deferment and rotation of grazing, and restricted use during dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This complex is not suited to cultivated crops, and the potential is low for this use. Steep slopes, shallow depth to bedrock, and rapid runoff are the main limitations. The hazard of water erosion is severe.

The potential is low for use of trees as windbreaks. Depth to bedrock, slopes, and insufficient soil moisture are the main limitations and erosion is a hazard to the successful establishment and growth of trees. The potential is medium for producing habitat for openland wildlife and is low for producing habitat for rangeland wildlife.

Areas of this complex have medium potential for most building site developments and sanitary facilities. Slopes and depth to bedrock are the main limitations for sanitary landfills, shallow excavations, dwellings, small commercial buildings, and local roads and streets.

The potential is medium for most recreational uses. Slopes and depth to bedrock are limitations for playgrounds. The moderately deep Woodward soils are better suited to recreational uses than Quinlan soils. Onsite investigation is necessary to properly evaluate and plan the development of specified sites for all uses.

This complex is in capability subclass VIe. The Woodward soils are in Loamy Prairie range site, and the Quinlan soils are in Shallow Prairie range site (fig. 14).

72—Yahola fine sandy loam, rarely flooded. This deep, well drained, nearly level soil is on bottom lands adjacent to the Salt Fork of the Red River and some of its tributaries. This soil is on positions slightly higher than the recent flood plain and is rarely flooded. Slope is 0 to 1 percent. Areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is reddish brown fine sandy loam about 12 inches thick. The underlying material is reddish brown fine sandy loam to a depth of about 80

inches and contains many thin strata of loam, loamy fine sand, and clay loam.

Natural fertility and organic matter content are medium. The pedon typically is moderately alkaline and calcareous throughout. Permeability is moderately rapid, and surface runoff is slow. The available water capacity is medium. The surface layer is very friable and easily tilled throughout a wide range of soil moisture. Root development is not restricted to a depth of about 80 inches.

Included with this soil in mapping are a few small areas of Clairemont and Lincoln soils. The included soils make up about 10 percent of mapped areas, but an individual area is less than 3 acres.

Most areas of this Yahola soil are used for cultivated crops. This soil has high potential for cultivated crops and is well suited to cotton, wheat, and grain sorghum. If this soil is used for cultivated crops, the hazard of wind erosion is moderate. The hazard of water erosion is slight. Minimum tillage, winter cover crops, and residue management help to prevent soil erosion, maintain organic matter content, and improve fertility and tilth.

The potential is high for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, alfalfa, and other adapted grasses and legumes. Proper stocking rates, rotation of grazing, and restricted use during prolonged wet and dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the grasses.

This soil has high potential for use as rangeland. If management is good, the production of native grasses is high. The potential is high for use of trees as windbreaks. The limitations for growing trees on this soil are few. The potential is high for producing habitat for openland wildlife and rangeland wildlife.

This Yahola soil has low potential for most building site developments and sanitary facilities. The rare flooding is a hazard for dwellings and small commercial buildings, septic tank absorption fields, and local roads and streets.

The potential is high for most recreational uses. This soil does not have significant limitations for use as playgrounds, picnic areas, and paths and trails. Rare flooding is a hazard for camp areas. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIe. It is in Loamy Bottomland range site.

73—Yahola fine sandy loam, occasionally flooded. This deep, well drained, nearly level soil is on flood plains that border the major drainageways. This soil is occasionally flooded. Slope is 0 to 1 percent. Most areas are long and narrow and range from 10 to 200 acres.

Typically, the surface layer is reddish brown fine sandy loam about 5 inches thick. The underlying material is reddish brown fine sandy loam stratified with thin layers of loam, silt loam, and loamy fine sand to a depth of about 80 inches.

Natural fertility and organic matter content are medium. The pedon is moderately alkaline and calcareous throughout. Permeability is moderately rapid, and surface runoff is slow. The available water capacity is medium. The surface layer is very friable and easily tilled throughout a wide range of soil moisture. Root development is not restricted to a depth of 80 inches or more.

Included with this soil in mapping are a few small areas of Clairemont soils. The included soils make up about 10 percent of mapped areas, but an individual area is generally less than 3 acres.

Most areas of this Yahola soil are used for cultivated crops. This soil has high potential for cultivated crops and is well suited to cotton, grain sorghum, and wheat. If this soil is used for cultivated crops, the hazards of wind and water erosion are moderate and intensive conservation measures are required. Minimum tillage, winter cover crops, windbreaks, and residue management help to prevent soil erosion, maintain organic matter content, and improve fertility and tilth.

The potential is high for tame pasture and hayland. This soil is suited to bermudagrass, weeping lovegrass, alfalfa, and other adapted grasses and legumes. Proper stocking rates, rotation of grazing, and restricted use during prolonged wet or dry periods help to keep the grasses and soil in good condition. Fertilizing tame pasture grasses increases the production of forage and improves the vigor of the plants.

This soil has high potential for use as rangeland. If management is good, the production of native grasses is high. The potential is high for use of trees as windbreaks. The limitations for growing trees on this soil are few. The potential is high for producing habitat for openland and rangeland wildlife.

This Yahola soil has low potential for most building site developments and sanitary facilities. Flooding and seepage are major concerns and are difficult to overcome.

The potential is medium for most recreational developments. Flooding is a major hazard for camp areas and playgrounds. Onsite investigation is essential to properly evaluate and plan the development of specified sites for all uses.

This soil is in capability subclass IIw. It is in Loamy Bottomland range site.

Prime Farmland

Prime farmland is one of several kinds of important farmlands defined by the U.S. Department of Agriculture. It is of major importance in providing the Nation's short- and long-range needs for food and fiber. The supply of high quality farmland is limited, and responsible levels of government, as well as individuals, must encourage and facilitate the best use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to producing food, feed, forage, fiber, and oilseed crops. It has the properties that are favorable for the economical production of sustained high yields of crops when it is treated and managed using acceptable farming methods. Of course, the moisture supply must be adequate, and the growing season has to be sufficiently long. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland in Harmon County may now be used as cropland, pastureland, or woodland, or it may be in other uses. It must either be used for producing food or fiber or be available for these uses. Urban land, built-up land, and water areas cannot be considered prime farmland.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. It also has favorable temperature and growing season and acceptable acidity or alkalinity. It has few or no rocks and is permeable to water and air. Prime farmland is not excessively erodible or saturated with water for long periods and is not flooded during the growing season. The slope ranges mainly from 0 to 5 percent. For more detailed information on the criteria for prime farmland consult the local staff of the Soil Conservation Service.

In this county about 128,868 acres, or 37 percent, is prime farmland. Areas are scattered throughout the county but most are in the central part. They are mainly in map units 2, 5, 6, and 7 on the general soil map. Approximately 86 percent of the prime farmland is used for cultivated crops, 2 percent is tame pasture, and 12 percent is rangeland. Minor areas are in windbreaks. Crops grown on this land are mainly cotton, grain sorghum, wheat, and alfalfa.

The recent trend to urban uses has been small. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and difficult to cultivate, and usually less productive.

Soil map units that make up prime farmland are listed in this section. This list does not constitute a recommendation for a particular land use. The location of the prime farmland soils is shown on the detailed soil maps in the back of this publication. The extent of each unit is given in table 4. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units." The map units in this list are prime farmland, except where they are used as urban or built-up land or where they do not meet the criteria for prime farmland.

1	Abilene loam, 0 to 1 percent slopes
2	Abilene loam, 1 to 3 percent slopes
5	Altus fine sandy loam, 0 to 1 percent slopes
6	Altus fine sandy loam, 1 to 3 percent slopes
7	Aspermont silt loam, 1 to 3 percent slopes
8	Aspermont silt loam, 3 to 5 percent slopes
11	Carey loam, 1 to 3 percent slopes
12	Clairemont silt loam, occasionally flooded
17	Devol fine sandy loam, 1 to 3 percent slopes
22	Grandfield fine sandy loam, 0 to 2 percent slopes
25	Hardeman fine sandy loam, 1 to 3 percent slopes
26	Hardeman fine sandy loam, 3 to 5 percent slopes
31	Hollister silty clay loam, 0 to 1 percent slopes
38	Madge loam, 0 to 1 percent slopes
39	Madge loam, 1 to 3 percent slopes
40	Mangum silty clay loam, occasionally flooded
41	Mangum silty clay, rarely flooded
44	McKnight fine sandy loam, 1 to 3 percent slopes
51	Shrewder fine sandy loam, 1 to 3 percent slopes
52	Shrewder fine sandy loam, 3 to 5 percent slopes
53	Spur clay loam, occasionally flooded
55	Tillman clay loam, 0 to 1 percent slopes
56	Tillman clay loam, 1 to 3 percent slopes
57	Tipton loam, 0 to 1 percent slopes
58	Tipton loam, 1 to 3 percent slopes
66	Westview silty clay loam, 0 to 1 percent slopes
67	Woodward loam, 1 to 3 percent slopes
68	Woodward loam, 3 to 5 percent slopes
72	Yahola fine sandy loam, rarely flooded
73	Yahola fine sandy loam, occasionally flooded

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Keith Vaughan, conservation agronomist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

More than 198,000 acres in Harmon County was used for crops and pasture in 1979 (*5*). Of this total, 9,400 acres was in permanent pasture; 125,000 acres was in wheat and other small grains; 55,900 acres was in cotton; 11,700 acres was in grain sorghum; and 6,000 acres was in alfalfa and other hay. The rest was in other crops or was idle cropland.

More than 123,000 acres in the county was used for rangeland in 1978. About 1,500 acres was used for woodland, mainly field windbreaks.

The soils in Harmon County have good potential for increased production of food crops. About 10,000 acres of potentially good cropland is in rangeland, although individual areas generally are small. About 9,400 acres is in pasture. Food production could also be increased by extending the latest crop production technology to all the cropland in the county.

The acreage in crops and pasture remains nearly constant from year to year. A few acres of marginal cropland are converted to rangeland each year. The acreage of urban and built-up land increases by about 10 acres each year. The use of this soil survey to help make land use decisions is discussed in the section "General Soil Map Units."

In Harmon County, soil erosion is the major hazard on about three-fourths of the cropland, rangeland, and pastureland. Where slope is more than 2 percent, erosion is a hazard. Aspermont, Carey, Devol, Grandfield, Hardeman, Quinlan, Tillman, Vernon, and Woodward soils have slopes of as much as 8 percent.

If the surface layer is lost through erosion, productivity is reduced and subsoil material is incorporated into the plow layer. Loss of the surface layer is especially damaging to Abilene, Grandfield, Tillman, Tipton, and Vernon soils that have a clayey or loamy subsoil and to Cornick, Knoco, Quinlan, Vernon, and Woodward soils in which bedrock restricts the depth of the root zone and the available water capacity. Productivity is reduced on soils that tend to be droughty, such as Quinlan and

Vernon soils. Also, erosion on farmland results in sedimentation of streams. Control of erosion minimizes the pollution of streams by sediment and improves the quality of water for municipal use, for recreational use, and for use by fish and wildlife.

Preparing a good seedbed and tilling are difficult in areas where the original friable surface soil has been eroded away and the less friable subsoil is exposed. This is a common concern in areas of moderately eroded Grandfield and Vernon soils.

Erosion control practices provide protective surface cover, reduce runoff, and increase infiltration. A cropping system that keeps vegetative cover on the soil for extended periods helps to reduce erosion and preserve the productive capacity of the soils. Forage crops in the cropping system reduce erosion on sloping land, provide nitrogen to plants, and improve tilth for the following crop.

In most areas of sloping Devol, Grandfield, and Nobscot soils, the surface is not uniform and is sandy. In these areas, a cropping system that provides abundant plant cover through minimum tillage helps to control erosion. Minimum tillage and stubble mulching leave crop residue on the surface and, thereby, help to increase water infiltration and reduce runoff and erosion. These practices are more difficult to use successfully on eroded soils.

Terraces and diversions reduce the length of slopes and thereby reduce runoff and erosion. They are better suited to deep, well drained soils that have regular slopes, such as Altus, Carey, Grandfield, Hardeman, Tillman, Tipton, Vernon, and Woodward soils. Some soils, for example Cornick, Knoco, Quinlan, Devol, and Nobscot soils, are less suited to terraces and diversions because slopes are strong, the surface is not uniform and is sandy, or bedrock is at a depth of less than 20 inches.

Contour tillage is commonly used in some areas of Carey, Hardeman, Quinlan, Tillman, and Woodward soils that have smooth uniform slopes.

Wind erosion is a hazard on the sandy Devol, Grandfield, Hardeman, Lincoln, and Nobscot soils. If the surface is dry and bare of vegetation or surface mulch, strong winds can damage these soils in a few hours. Maintaining plant cover, using surface mulch, and roughening the surface through tillage minimize wind erosion on these soils. Shrubs and tree windbreaks are effective in reducing the wind erosion.

Information on erosion control practices for each kind of soil can be obtained in local offices of the Soil Conservation Service.

Drainage is the major management need in some small areas of cropland. Some areas of soils are so wet and salty that the production of common crops is very low or generally not possible. Examples are the Beckman soils and the somewhat poorly drained Gracemont and Gracemore soils, which make up about 4,300 acres in the county. Altus, Grandfield, Hollister, and Tipton soils have good natural drainage most of the year, but in low areas water tends to pond after rains because surface drainage is inadequate. The ponded areas are generally less than 2 acres. At the heads of drainageways in some areas Devol, Grandfield, and McKnight soils are spots that tend to be wet and salty. The spots are the result of the lateral movement of water over impermeable clayey red beds that underlie these soils. They are less than 5 acres and are shown on the detailed soil maps.

The design of surface and subsurface drainage systems varies with the kind of soil. A combined surface and subsurface system is needed in some areas of the Gracemont soils. Finding adequate outlets for drainage systems is difficult in some areas. Information on drainage design for each kind of soil can be obtained in local offices of the Soil Conservation Service.

Natural fertility in most of the soils on uplands is medium to high. The sandy, light colored soils, such as Devol, Grandfield, and Nobscot, are generally lower in fertility than the dark, loamy soils such as Tipton, Altus, and Carey. Soils on the flood plains, such as Clairemont, Spur, and Yahola have higher natural fertility than most soils on uplands.

The natural fertility has been depleted in most of the cultivated soils, and fertilizer applications are needed for good yields. Some soils need additions of nitrogen, phosphorus, and potassium. On all soils, the amount of fertilizer used should be based on the results of soil tests, on the needs of the crop, and on the expected yield. The Cooperative Extension Service can help to determine the kind and amount of fertilizer to apply.

Most of the cultivated soils north of the Salt Fork of the Red River and along Sandy Creek have a brown or dark brown loam or very fine sandy loam surface layer. The organic matter content is medium or high, and structure is weak to moderate. Intensive rainfall causes the surface of these soils to crust. This reduces the amount of water infiltration and increases runoff and the susceptibility to wind erosion.

The light colored, sandy soils have poor structure and are highly susceptible to wind erosion at any time of the year. Leaving crop residue on the surface of these soils and tilling to leave a rough cloddy surface help to prevent wind erosion. Some of these soils form a very hard surface crust in spring and summer that germinating seeds cannot break through. Addition of organic material, such as manure or cotton burs, improves soil structure, reduces the hazard of wind erosion, and reduces surface crusting.

The dark brown and red, clayey soils, such as Tillman, Hollister, and Vernon soils, have poor tilth in spring because they remain wet for long periods. If they are plowed when wet, the surface layer becomes cloddy when it dries and a good seedbed is difficult to prepare. Fall plowing generally results in good tilth in spring. Most

of these soils are used for wheat. A combination of minimum tillage and leaving crop residue on the surface results in good tilth, better stands, and higher yields.

Field crops suited to the soils and climate of the survey area include many that are not now commonly grown. Cotton and grain sorghum are the major row crops; however, guar, sunflowers, soybeans, mung beans, peanuts, and other crops similar to these are suited. Wheat and rye are the common close-growing crops. Oats, barley, millet, and sorghum can be grown, and seed could be produced from rye, vetch, alfalfa, and weeping lovegrass.

Specialty crops are not extensively grown in the county. Watermelons and peaches are commercially grown on a few acres of sandy soils south of the Salt Fork of the Red River. Okra, strawberries, blackberries, sweet corn, tomatoes, beans, peas, peppers, cantaloupes, grapes, and other vegetables are suited where intensive cropping and a high level of technology can be used. Deep soils that have good natural drainage and that warm up early in spring are especially well suited to vegetables and small fruits. Examples include Altus, Carey, Clairemont, Devol, Grandfield, Hardeman, Nobscot, Tipton, Woodward, and Yahola soils. Irrigation is essential for good yields in most years. Most of the well drained soils in the survey area are suitable for orchards and nursery plants. Soils in low areas where frost is frequent and air drainage is poor, however, generally are poorly suited to early vegetables, small fruits, and tree fruits. Pears, apricots, peaches, and apples are the most important tree fruits grown in the county. Latest information and suggestions for growing specialty crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

In general, the soils in the survey area that are well suited to crops are also well suited to urban development. The data about specific soils in this soil survey can be used in planning future land use patterns. Potential productive capacity in farming should be weighed against soil limitations and potential for nonfarm development.

In some areas, however, the soils are well suited to farming but poorly suited to nonfarm development. These areas are identified as map units 1 and 2 on the general soil map at the back of this publication. In these areas the dominant soils are Yahola, Lincoln, Gracemore, Mangum, and Spur soils, all of which are on flood plains and are subject to flooding. The flooding creates serious hazards for nonfarm development.

Some of the soils in the county are poorly suited to both farming and urban development. These soil areas are in map unit 8 on the general soil map. Mainly they are Knoco, Vernon, and Cornick soils.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Tame Pasture

Larry Odom, district conservationist, Soil Conservation Service, helped prepare this section.

About 1 percent of the acreage in the survey area is in tame pasture. Some fields of marginal cropland are being converted to tame pasture. Also, small areas in which native range is in poor condition are being converted to tame pasture, especially areas of sandy soils where shinnery oak is being cleared. Most of the soils in the survey area are suited to tame pasture.

The main tame grasses utilized are improved bermudagrass and improved lovegrass. Weeping lovegrass provides good quantity and quality of forage on soils that were previously heavily infested with shinnery oak and sand sagebrush. It is used in conjunction with winter pasture of small grains to provide dry matter for livestock. It also provides excellent forage

for livestock in early spring when deferment of native range grasses is needed. When used as pasture early in spring and in summer, lovegrass should be fertilized and grazing should be managed in a pasture rotation system. Cattle need to be rotated from one pasture to the next each 14 to 21 days.

Midland bermudagrass is the other main tame pasture grass in the county. For maximum production, stands should be regularly fertilized in split applications of 75 pounds of actual nitrogen every 21 days if moisture is available.

Bermudagrass, lovegrass, and native grasses should be fenced and managed in separate pasture. This will allow the most efficient management of the grasses for maximum production. Also maximum utilization of the forage can be obtained without the cattle overgrazing one grass species and underutilizing the other.

Proper grazing and rotational grazing help to lengthen the life of most pasture plants. Deferred grazing during the time pasture plants are under low food reserve is beneficial. This allows the plants to regain vigor by helping to maintain a more adequate root system where food can be stored for the next growing season. Total production of forage can be increased.

Plant food that contains the proper elements contributes to the vigor of the pasture plants, increases forage production, and lengthens the lifespan of the plants. Plant food can be added by using commercial fertilizers, or by growing grasses in conjunction with legumes, such as vetch seeded in bermudagrass to furnish nitrogen to the grass plant. Larger amounts of commercial fertilizers are needed in areas where legumes are not grown with the grass.

Controlling the invasion of undesirable plants helps to maintain the desired kind of pasture plants in a stand. Weeds need to be controlled, and brush management is essential. Proper mowing and spraying help to reduce the invasion and competition of weeds and brush.

A pasture program needs to be planned to provide the desired amount of forage during each month of the year. A study of the growth habits of the different plants is necessary to assure adequate forage during each month. The months that various kinds of forage plants grow are indicated in fig. 15. The percent of growth that can be safely grazed each month without substantially reducing total yield for each kind of plant is illustrated. For example, 20 percent of the yearly growth of bermudagrass can be grazed during June.

Soils vary in their ability to produce forage for grazing. The Tipton soil produces more forage than the Woodward soil primarily because it furnishes more available moisture to the plant. The total yearly production of each soil for various kinds of pasture plants is given in animal unit months (AUM) in table 6. Tipton loam, 1 to 3 percent slopes, in bermudagrass pasture, can furnish grazing for one animal unit for 5.5 months during the year.

In planning a pasture program, one must consider the total yearly production of the pasture plant in AUM and the amount of growth the plant makes for a certain month. As illustrated in figure 15, bermudagrass furnishes 20 percent of its annual forage during June. Bermudagrass provides grazing for 1.2 animals (.20 x 6 AUM = 1.1 AUM) on the Tipton soil since its yearly production is 5.5 AUM as indicated in table 6. A pasture of 50 acres would then furnish grazing for 50 animals (50 acres x 1.1 AUM = 50 AUM) during June. Personnel in the Soil Conservation Service can assist in planning a total pasture program.

Periods of low rainfall are common and may last for a month or more and may be below average for a year or more. Yields in table 6 are an average over several years. To insure continuous adequate forage during these dry periods, either numbers of livestock must fluctuate or a reserve is needed. This reserve can be provided in two ways: By harvesting part of the pasture for hay during periods of above normal moisture and by holding over growth from the growing season to a later period. For example, use of a reserve pasture of bermudagrass grown in May and June can be delayed until a dry period in August and September which occurs occasionally. However, close grazing during August and September should be avoided because this is the period when storage roots are developed so the plants can survive winter.

To extend the grazing season in the survey area, supplemental irrigation is used. A good fertilization program coupled with irrigation aids in extending the normal grazing season during periods of prolonged summer drought.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and

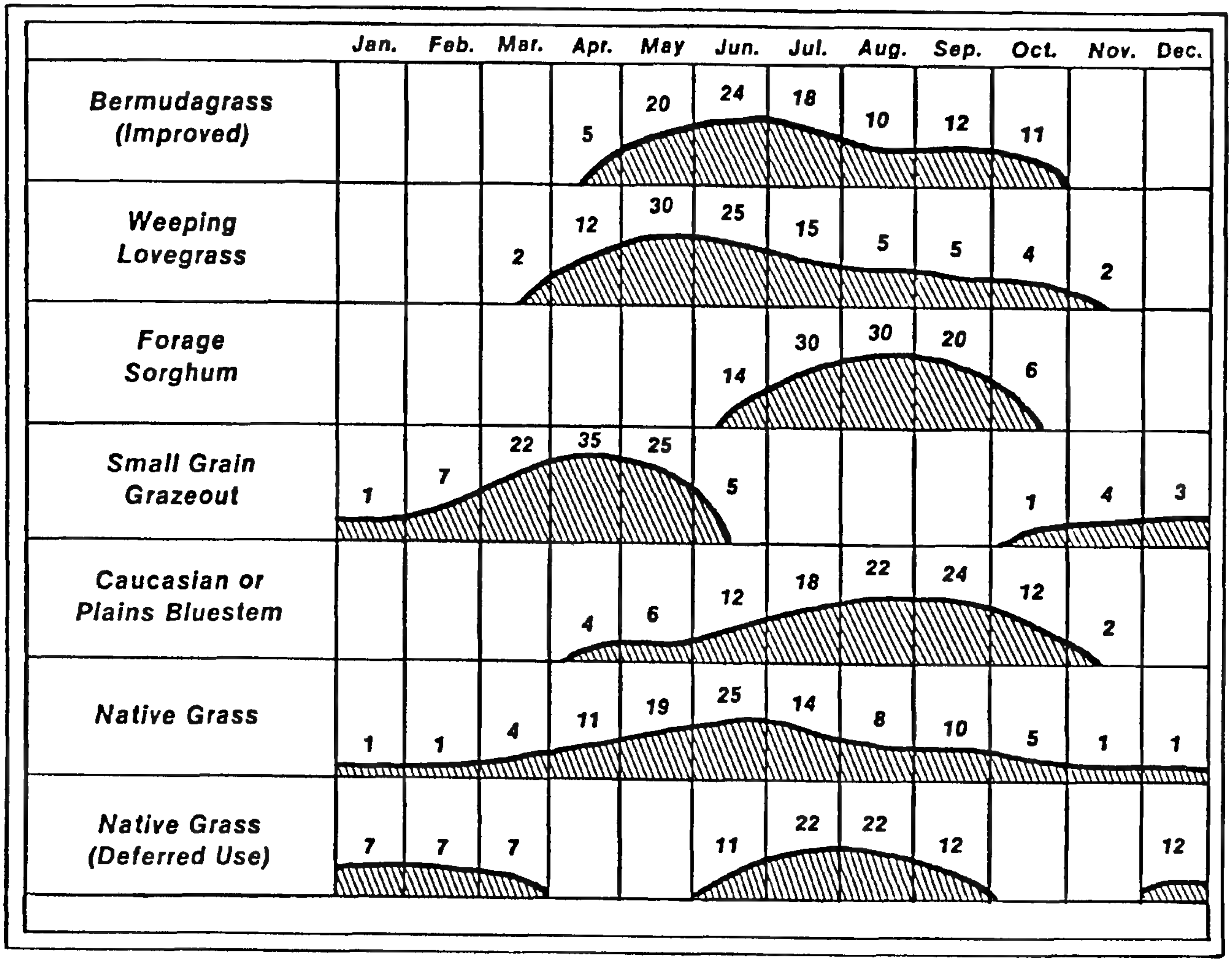


Figure 15.—Forage calendar showing percentage of use of major grasses.

narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless

close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Irrigation

Bobby G. Day, civil engineer, Soil Conservation Service, helped prepare this section.

Significant irrigation farming started in Harmon County in 1942. Irrigation developed rapidly during the early 1950's. By 1955 more than 300 wells had been drilled and more than 25,000 acres had been developed for irrigation. The acreage of irrigated land has gradually increased to about 28,000 acres (fig. 16).

When irrigation first developed, practically all of the water was distributed by open head ditches and furrows. In the early 1970's, many irrigators changed from furrow systems to sprinkler systems. This change required less labor and improved efficiency. At present almost half of the irrigated acreage is watered by sprinklers. The most common types of sprinkler systems used are the side-roll and the center-pivot, self-propelled. Most of the open ditches have been replaced with underground plastic pipe and surface aluminum pipe.

Essentially all of the water for irrigation comes from wells. The Dog Creek Shale and the Blaine Formation are the aquifers from which the water is pumped. These aquifers consist of gypsum cavities and solution channels. Most irrigation wells range from 100 to 200 feet in depth and normally produce 500 to 1,000 gallons of water per minute but range from 10 to 2,000 gallons.

The ground water aquifers in this area are recharged mainly by infiltrating rainfall and subsurface flow. After rains, water can be observed flowing into the many sinkholes in the area. Water levels in irrigation wells have been known to raise immediately after a rain. The Oklahoma Water Resources Board estimates that the Dog Creek Shale and the Blaine Formation have a storage capacity of 320,000 acre feet of which about one-third is available for pumping. The annual recharge rate is estimated to be about 50,000 acre feet. This is also approximately the annual pumping rate. After 2 or 3 years in which rainfall is below normal, the underground water supply becomes depleted. Recharging the aquifers has been aided by developing recharge wells and improving natural gypsum sinks so that they collect and return rainfall runoff to the water-bearing layers. There are approximately 35 recharge wells and 15 improved gypsum sinks in the county.

Figure 16.—Gravity flow irrigation of cotton on Tipton loam, 0 to 1 percent slopes.

Water from the Dog Creek Shale and the Blaine Formation is highly mineralized. It is not generally suitable for domestic or municipal supplies. However, it has been used throughout the area for irrigation without apparent ill effects to the soil or crops. Because of the poor quality of the water, it is desirable for an irrigator to monitor the water on a regular basis.

The two major crops irrigated are cotton and wheat. More than 50 percent of the irrigated acreage is in

cotton, approximately 25 percent is in wheat, 15 percent is in grain sorghum, and 10 percent is in alfalfa and pasture.

Rangeland

Ernest C. Snook, range conservationist, Soil Conservation Service, assisted in the preparation of this section.

Rangeland is land on which the native vegetation consists of a wide variety of grasses, grasslike plants, forbs, shrubs, and trees. The vegetation is generally suitable for grazing, and production is sufficient to support grazing. Rangeland does not receive regular or frequent cultural treatment. The composition and production of the plant community is determined by soil, climate, topography, overstory canopy, and grazing management.

According to records of the local field office of the Soil Conservation Service, 40 percent of Harmon County is rangeland. Rangeland originally produced a wide variety of tall and mid grasses interspersed with an abundance of forbs.

Four distinct types of rangeland exist in Harmon County: (1) In the eastern part of the county, mainly in the Turkey Creek watershed, most of the soils are clayey and are very shallow to shallow over shale or clayey sediment. These soils support mid and short grasses, and potential productivity is low because of the shallow root zones. (2) In the southern and northern parts of the county, many of the soils are loamy and clayey and are very shallow to moderately deep over shale, clayey sediment, or gypsum. Large areas are steep and have escarpments. These soils support tall, mid, and short grasses, and potential productivity is low because of the shallow root zone and the low available water capacity. (3) In the central part of the county, the soils are sandy and are deep over sandy sediment. Areas of these soils are hummocky, and wind erosion is a hazard. These soils support tall grasses, and potential productivity is much higher than on the shallow soils. Many of these soils were once cultivated but have been reseeded to grasses. (4) In the north-central part of the county, the soils are loamy and are shallow to deep over soft sandstone. These soils support mid and tall grasses, and the potential productivity is high.

The plant communities in rangeland have changed drastically during the past 50 years. Heavy overgrazing has deteriorated most of the grassland, and much of the high quality vegetation has been grazed out. Now, tall grasses flourish only in a few places. Areas that were once open grassland are now covered with mesquite or shinnery oak and a mixture of short to mid grasses and poor quality forbs. The amount of forage presently produced may be less than half of that originally produced. However, remnants of the original plant species are in protected areas on most grasslands, and in most cases, good grazing management can help to reestablish these high quality plants.

The livestock enterprise in Harmon County is mainly cow-calf operations; however, many farms and ranches have various operations in the management of stocker cattle. This provides greater flexibility in adjusting the number of livestock to be managed during periods of drought. The grazing of native grassland is generally supplemented with forage from improved pasture on crops. Improved bermudagrass and weeping lovegrass are the most commonly grown tame pasture grasses. To feed livestock in winter, protein supplement, hay, and grazing of small grains are used in conjunction with the grazing of native range.

Approximately 75 percent of the annual production of forage is in spring when rains and moderate temperatures are favorable for the growth of warm-season plants. A secondary growth period generally is in fall when rains and gradually cooling temperatures are common.

Droughts of varying length are common in the county. A short drought generally occurs in midsummer of each year. Frequently, periods of drought last for several months.

Range Sites and Condition Classes

Table 7 shows, for each soil, the range site and the total annual production of vegetation in favorable, normal, and unfavorable years. Only those soils that are used as or are suited to rangeland are listed. Explanation of the column headings in table 7 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Climax vegetation on the range site is the stabilized plant community that the site is capable of producing. It consists of the plants that were growing there when the region was first settled. This plant community reproduces itself and remains unchanged as long as the environment does not change. If cultivated crops are not grown, the most productive combination of forage plants on a range site is generally the climax vegetation.

Decreasers or preferred plants are in the climax vegetation and tend to decrease in relative amount under continuous overgrazing. They generally are the tallest and most productive perennial grasses and forbs and are the most palatable to livestock.

Increasers or desirable plants increase in relative amount as the more desirable decreaser plants are reduced by continuous overgrazing. They are commonly shorter than decreasers and are generally less palatable to livestock.

Invaders or undesirable plants cannot compete with plants in the climax plant community for moisture, nutrients, and light. However, invaders grow along with increasers after the climax vegetation has been reduced by overgrazing. Some invaders have little value for grazing.

Range condition is judged according to the standards that apply to a particular range site. It is the present kind and amount of vegetation in relation to the climax plant community for that site.

Four range condition classes indicate the degree of departure from the potential, or climax, vegetation. The classes indicate the present condition of the native vegetation on a range site as compared to the native vegetation that could grow there. A range is in excellent condition if 76 to 100 percent of the vegetation is of the same kind as that in the climax stand; in good condition if the percentage is 51 to 75; in fair condition if the percentage is 26 to 50; and in poor condition if the percentage is 25 or less.

Potential forage production depends on the range site. Current forage production depends on the range condition and the moisture available to plants during the growing season. The *potential annual production* is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a *favorable* year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a *normal* year, growing conditions are about average. In an *unfavorable* year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre reduced to a common percent of air-dry moisture.

A primary objective of good range management is to keep range in excellent or good condition. If the range is well managed, water is conserved, forage yields are improved, and the soils are protected. The main concern in management is recognizing important changes in the kind of cover on a range site. These changes take place gradually and can be misinterpreted or overlooked. Growth encouraged by heavy rainfall may lead to the conclusion that the range is in good condition, whereas actually the cover is weedy and the long-term trend is toward lower production. On the other hand, some rangeland that has been closely grazed for short periods under the supervision of a careful manager may have a degraded appearance that temporarily conceals its quality and ability to recover. Following years of prolonged overgrazing of rangeland, seed sources of the desirable vegetation will be eliminated. When this happens, the vegetation needs to be reestablished for management to be effective.

Range management practices suitable for Harmon County are proper grazing use, deferred grazing, or a planned grazing system. Other benefits in range management are stock water development, favorable fencing, and deployment of salt, mineral, and feeding stations. When the condition of range site is regressing and undesirable plants become dominant, practices such as range seeding, brush management, weed management, and prescribed burning should be considered singly or in combination with other management practices.

Good management, properly applied and maintained, generally results in the optimum production of vegetation, reduction of undesirable species, conservation of water, and control of erosion. In some sites, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

The following guidelines are provided for potential annual use on a broad scale. When more detail is needed, consult the local office of Soil Conservation Service.

To maintain or improve the quality and quantity of native vegetation, the amount of removal depends on the potential productivity and condition of the site. As a rule of thumb, approximately 50 percent of the annual production should be left on the soil surface. One-third of the height of grasses (tall and mid) equals 50 percent of the annual production at maturity. When 50 percent of annual production remains on the site, the natural resources of soil, plant, animal, and environment are considered to be in balance. The remaining annual production may or may not be removed from the site. The removal of vegetation from a site may be by micro-organisms, rodents, insects, and mammals or by deterioration caused by climatic variations.

Generally, livestock remove approximately 50 percent of the total annual production of vegetation from the site, or 25 percent by air-dry weight. For example, in table 7 the forage available on a Loamy Prairie range site in excellent condition for an average year is 2,800 pounds of air-dry material. This 2,800 pounds includes all plant production as grasses, forbs, and woody species. Approximately 25 percent, or 700 pounds, of the average plant production is available for livestock forage. Generally, woody species would not be considered livestock forage. A 1,000 pound cow, an equivalent animal unit, consumes 2 1/2 to 3 percent of her body weight of forage per day, or 25 to 30 pounds of air-dry

forage. In one month, or 30 days, an animal unit consumes 750 to 900 pounds of native vegetation, mainly grasses, depending on quality and stage of growth.

To convert available forage from 1 acre of Loamy Prairie range site in excellent condition to animal units, divide 700 pounds of production by 25 to 30 pounds (the forage required per day per animal unit). Thus, 1 acre will produce forage for an animal unit for 28 to 23 days. To convert available forage from 1 acre to an animal unit month, divide available forage (700 pounds) by forage requirement for an animal unit (750 or 900 lbs). The results would be 0.93 animal unit months if 750 pounds available forage is required and 0.78 animal unit months if 900 pounds available forage is required. The examples show that 12.9 to 15.4 acres of Loamy Prairie range site in excellent condition would be required to provide forage for an animal unit for 12 months.

Descriptions of Range Sites

Nineteen range sites are recognized in Harmon County. They are described on the pages that follow. Each description names the map units in the range site, gives the composition of the potential plant community, and lists the preferred, desirable, and undesirable plants.

The range site designation for each soil in the county can be found in table 7. The names of range sites for map units are given in the "Detailed Soil Map Units" section.

Breaks Range Site

The Knoco soil in map unit 35 and the Quinlan soil in map unit 48 are in this site.

The potential plant community has a mid and tall grass aspect. The composition by weight is 93 percent grasses, 5 percent forbs, and 2 percent woody plants. Little bluestem, sand bluestem, sideoats grama, compassplant, prairie-clover, and catclaw sensitivebrier are preferred plants. They make up 60 percent of the forage if range is in excellent condition. As preferred plants disappear under continuous overgrazing, they are replaced by desirable plants, such as hairy grama, tridens, blue grama, sagewort, skunkbush, and sumac.

Continuous overgrazing and extreme climatic conditions can cause a decline in the desirable plants. If the plant community regresses, undesirable plants, such as hairy tridens, threeawn, annual grasses and weeds, redcedar, and mesquite dominate the site. As undesirable plants increase, potential forage production is reduced.

Deep Sand Range Site

The Devol soils in map units 14, 15, and 16, the Grandfield soils in map units 20 and 21, the Grandmore soils in map unit 24, the Likes soils in map units 30 and 36, and the McKnight soils in map units 42 and 43 are in this site.

The potential plant community has a tall and mid grass aspect. The composition by weight is 87 percent grasses, 3 percent forbs, and 10 percent woody plants. Little bluestem, sand bluestem, indiangrass, switchgrass, and tephrosia are preferred plants. They make up 50 percent or more of the forage if range is in excellent condition. As preferred plants disappear under continuous overgrazing, they are replaced by desirable plants, such as blue grama, sand lovegrass, Texas bluegrass, sand paspalum, tall dropseed, sideoats grama, Scribner panicum, bigtop dalea, queensdelight, sand sagebrush, skunkbush, and sand plum.

Continuous overgrazing and extreme climatic conditions can cause a decline in the desirable plants. If the plant community regresses, undesirable plants, such as sand dropseed, sandbur, threeawn, red lovegrass, purple sandgrass, wild buckwheat, and camphorweed dominate the site. As undesirable plants increase, potential forage production is reduced.

Deep Sand Savannah Range Site

The Nobscot soils in map units 45 and 46 are in this site.

The potential plant community has a tall grass aspect. The composition by weight is 85 percent grasses, 5 percent forbs, and 10 percent woody plants. Sand bluestem and little bluestem are dominant and along with switchgrass, indiangrass, and legumes are preferred plants. They make up 60 percent or more of the forage if range is in excellent condition. As preferred plants disappear under continuous overgrazing, they are replaced by desirable plants, such as sideoats grama, blue grama, hairy grama, purpletop, Scribner panicum, and scurfpea.

Continuous overgrazing and extreme climatic conditions can cause a decline in the desirable plants. If the plant community regresses, undesirable plants, such as sandbur, sand dropseed, threeawn, ragweed, and shinnery oak dominate the site. In undesirable range, blowouts are evident. As undesirable plants increase, potential forage is reduced.

Dune Range Site

The Tivoli soil in map unit 59 is in this site. Areas of this site are difficult to keep stabilized under the best of management.

The potential plant community has a tall grass and shrub aspect. The composition by weight is 80 percent grasses, 5 percent forbs, and 15 percent woody plants. Sand bluestem, little bluestem, switchgrass, big sandreed, and sand lovegrass are preferred plants. They make up 80 percent or more of the forage if range is in excellent condition. As preferred plants disappear under continuous overgrazing, they are replaced by desirable plants, such as sand dropseed, Scribner panicum, Texas

bluegrass, blue grama, sideoats grama, sand paspalum, sand sagebrush, and skunkbush.

Continuous overgrazing and extreme climatic conditions can cause a decline in the desirable plants and result in active blowouts. Lemon scurfpea, blowoutgrass, and big sandreed can be established to help stabilize blowouts and dunes. If the plant community regresses, undesirable plants, such as red lovegrass, purple sandgrass, threeawn, sandbur, ragweed, annual buckwheat, and annual grasses and weeds dominate the site. As undesirable plants increase, potential forage production is reduced.

Eroded Prairie Range Site

The Aspermont soil in map unit 32 is in this site. This site is generally in formerly cultivated land.

The potential plant community has a mid and tall grass aspect. The composition by weight is 97 percent grasses, 1 percent forbs, and 2 percent woody plants. Little bluestem, sand bluestem, indiangrass, and switchgrass are preferred plants. They make up 60 percent or more of the forage if range is in excellent condition. As preferred plants disappear under continuous overgrazing, they are replaced by desirable plants, such as sideoats grama, blue grama, hairy grama, buffalograss, silver bluestem, tall dropseed, bigtop dalea, dotted gayfeather, sumac, and sand plum.

Continuous overgrazing and extreme climatic conditions can cause a decline in the desirable plants. If the plant community regresses, undesirable plants, such as threeawn, annual brome, common broomweed, ragweed, yarrow, and redcedar dominate the site. As undesirable plants increase, potential forage production is reduced.

Eroded Red Clay Range Site

The Knoco soil in map unit 32 and Badland in map unit 33 are in this site.

The potential plant community is difficult to identify because of active erosion. The vegetation is unstable and quite variable. Sideoats grama is the major preferred grass. Alkali sacaton and silver bluestem are common, little bluestem and sand bluestem are in pockets of deeper soil, vine-mesquite and western wheatgrass are in places where extra moisture is available. Preferred forbs are Oklahoma sundrop, halfshrub sundrop, tenpetal mentzelia, nailwort, and bluets. The preferred plants make up 40 percent of the forage if range is in excellent condition. As preferred plants disappear under continuous overgrazing, they are replaced by desirable plants, such as sand dropseed, buffalograss, and tridens, and a number of legumes, such as James rushpea, trailing ratany, and prairieclover. Common poisonous legumes are creamy loco, Missouri loco, and silky sophora.

Continuous overgrazing and extreme climatic conditions can cause a decline in the desirable plants. If the plant community regresses, undesirable plants, such as tumblegrass, windmillgrass, pricklypear, mesquite, and annual grasses and forbs dominate the site. As undesirable plants increase, potential forage production is reduced.

Eroded Sandyland Range Site

The Likes and Devol soils in map unit 60 are in this site. The site is in formerly cultivated land and is severely eroded.

The potential plant community has a mid and tall grass aspect. The composition by weight is 95 percent grasses, 3 percent forbs, and 2 percent woody plants. Little bluestem, sideoats grama, sand bluestem, switchgrass, and indiangrass are preferred plants. They make up 70 percent or more of the forage if range is in excellent condition. As preferred plants disappear under continuous overgrazing, they are replaced by desirable plants, such as sand lovegrass, tall dropseed, Canada wildrye, fall witchgrass, sand dropseed, silver bluestem, sand plum, and shinnery oak.

Continuous overgrazing and extreme climatic conditions can cause a decline in the desirable plants. If the plant community regresses, undesirable plants, such as threeawn, sandbur, wild buckwheat, and other annual grasses and weeds gradually dominate the site. As undesirable plants increase, potential forage production is reduced.

Gyp Range Site

The Cornick soils in map units 13 and 34 are in this site. About 20 to 50 percent of the acreage has good potential for grass production, and 50 to 80 percent has very low potential or is barren.

The potential plant community predominantly has a mid and short grass aspect. The composition by weight is 92 percent grasses and 8 percent forbs. Little bluestem and sand bluestem are preferred plants. They make up 40 percent or more of the forage if range is in excellent condition. As preferred plants disappear under continuous overgrazing, they are replaced by desirable plants, such as sideoats grama, blue grama, rough tridens, sand dropseed, hairy grama, buffalograss, legumes, and forbs. The dominant forb is hairy goldaster.

Continuous overgrazing and extreme climatic conditions can cause a decline in the desirable plants. If the plant community regresses, undesirable plants, such as hairy tridens, threeawn, whorled dropseed, mesquite, and pricklypear gradually dominate the site. As undesirable plants increase, potential forage production is reduced.

Hardland Range Site

The Abilene soils in map units 1 and 2, the Aspermont soils in map units 7, 8, and 9, the Hollister soil in map

unit 31, the Quanah soils in map unit 47, and the Tillman soils in map units 55 and 56 are in this site.

The potential plant community has short and mid grass aspect. The composition by weight is 98 percent grasses and 2 percent forbs. Sideoats grama and western wheatgrass along with small amounts of sand bluestem, little bluestem, and switchgrass are preferred plants. They make up 55 percent or more of the forage if range is in excellent condition. As preferred plants disappear under continuous overgrazing, they are replaced by desirable plants, such as blue grama, buffalograss, vine-mesquite, meadow dropseed, silver bluestem, heath aster, and threelobe false-mallow.

Continuous overgrazing and extreme climatic conditions can cause a decline in the desirable plants. If the plant community regresses, undesirable plants, such as threeawn, sand dropseed, broomweed, western ragweed, pricklypear, mesquite, and annual grasses and weeds dominate the site. As undesirable plants increase, potential forage production is reduced.

Heavy Bottomland Range Site

The Mangum soils in map units 40 and 41 are in this site.

The potential plant community has a tall and mid grass aspect. The composition by weight is 97 percent grasses and 3 percent forbs. Sand bluestem, switchgrass, little bluestem, vine-mesquite, and western wheatgrass are preferred plants. They make up 55 percent or more of the forage if range is in excellent condition. As preferred plants disappear under continuous overgrazing, they are replaced by desirable plants, such as blue grama, buffalograss, longspike tridens, and Illinois bundleflower.

Continuous overgrazing and extreme climatic conditions can cause a decline in the desirable plants. If the plant community regresses, undesirable plants, such as curlycup gumweed, annual grasses and weeds, and mesquite gradually dominate the site. As undesirable plants increase, potential forage production is reduced.

Heavy Bottomland (moderately alkaline) Range Site

The Beckman soil in map unit 10 is in this site. This site supports alkali-tolerant plants. Some small areas are barren of vegetation. Commonly, alkali spots or slickspots are intermingled with the Beckman soil.

The potential plant community has a mid grass aspect. The composition by weight is 98 percent grasses and 2 percent forbs. Switchgrass, alkali sacaton, western wheatgrass, and vine-mesquite are preferred plants. They make up 50 percent of the forage if range is in excellent condition. As preferred plants disappear under continuous overgrazing, they are replaced by desirable plants, such as blue grama, inland saltgrass, longspike tridens, buffalograss, silver bluestem, and tall dropseed.

Continuous overgrazing and extreme climatic conditions can cause a decline in the desirable plants. If plant community regresses, undesirable plants, such as dropseed, windmillgrass, little barley, annual brome, threeawn, annual weeds, saltcedar, rushes, sedges, and mesquite dominate the site. As undesirable plants increase, potential forage production is reduced.

Loamy Bottomland Range Site

The Clairemont soil in map unit 12, the Spur soils in map units 53 and 54, and the Yahola soils in map units 72 and 73 are in this site.

The potential plant community has a tall grass aspect. The composition by weight is 94 percent grasses, 5 percent forbs, and 1 percent woody plants. Sand bluestem, switchgrass, little bluestem, indiangrass, eastern gamagrass, and compassplant are preferred plants. They make up 80 percent or more of the forage if range is in excellent condition. As preferred plants gradually disappear under continuous overgrazing, they are replaced by desirable plants, such as tall dropseed, sideoats grama, western wheatgrass, vine-mesquite, Canada wildrye, sedges, and heath aster.

Continuous overgrazing and extreme climatic conditions cause a decline in the desirable plants. If the plant community regresses, undesirable plants, such as buffalograss, blue grama, windmillgrass, annual brome, threeawn, ragweed, ironweed, and broomweed dominate the site. As undesirable plants increase, potential forage production is reduced.

Loamy Prairie Range Site

The Vinson soils in map units 3, 4, and 13; the Carey soil in map unit 11; the Madge soils in map units 38 and 39; the Woodward soils in map units 49, 67, 68, 69, 70, and 71; the Tipton soils in map units 57 and 58; and the Westview soil in map unit 66 are in this site.

The potential plant community primarily has a mid and tall grass aspect. The composition by weight is 97 percent grasses and 3 percent forbs. Sand bluestem, little bluestem, switchgrass, indiangrass, western wheatgrass, leadplant, Illinois bundleflower, and Maximilian sunflower are preferred plants. They make up 75 percent or more of the forage if range is in excellent condition. As preferred plants disappear under continuous overgrazing, they are replaced by desirable plants, such as sideoats grama, blue grama, buffalograss, scurfpea, Louisiana sagewort, and heath aster.

Continuous overgrazing and extreme climatic conditions cause a decline in the desirable plants. If the plant community regresses, undesirable plants, such as sand dropseed, silver bluestem, windmillgrass, mesquite, and annual grasses and weeds dominate the site. If management is poor, woody plants, such as sand sagebrush, skunkbush, hackberry, mesquite, and coralberry tend to invade this site. As undesirable plants increase, potential forage production is reduced.

Red Clay Prairie Range Site

The Knoco soils in map units 33, 34, and 65 and the Vernon soils in map units 62, 63, 64, and 65 are in this site.

The potential plant community has a mid grass aspect. The composition by weight is 96 percent grasses, 3 percent forbs, and 1 percent woody plants. Little bluestem is dominant on the site along with sideoats grama, halfshrub sundrop, and prairie-clovers. Sand bluestem, vine-mesquite, and western wheatgrass grow in areas that receive extra moisture. These preferred plants make up 70 percent or more of the forage if range is in excellent condition. As preferred plants disappear under continuous overgrazing, they are replaced by desirable plants, such as blue grama, buffalograss, hairy grama, rough tridens, purple threeawn, dotted gayfeather, Indian paintbrush, penstemon, and rushpea.

Continuous overgrazing and extreme climatic conditions cause a decline in the desirable plants. If the plant community regresses, undesirable plants, such as hairy tridens, broomweed, plains coreopsis, annual threeawn, annual cool season grasses, pricklypear, and mesquite dominate the site. As undesirable plants increase, potential forage production is reduced.

Sandy Bottomland Range Site

The Lincoln soil in map unit 37 is in this site. Areas of this site are unstable because of overflow sedimentation and wind erosion.

The potential plant community has a tall and mid grass aspect. The composition by weight is 95 percent grasses, 3 percent forbs, and 2 percent woody plants. Sand bluestem, little bluestem, indiangrass, Canada wildrye, and switchgrass are preferred plants. They make up 50 percent or more of the forage if range is in excellent condition. As preferred plants disappear under continuous overgrazing, they are replaced by desirable plants, such as big sandreed, tall dropseed, sideoats grama, willow, and cottonwood.

Continuous overgrazing and extreme climatic conditions cause a decline in the desirable plants. If the plant community regresses, undesirable plants, such as sand dropseed, windmillgrass, silver bluestem, threeawn, showy chloris, lovegrasses, sandlily, and annual grasses and weeds dominate the site. As undesirable plants increase, potential forage production is reduced.

Sandy Prairie Range Site

The Altus soils in map units 5 and 6; the Devol soils in map units 17 and 30; the Grandfield soils in map units 22 and 23; the Hardeman soils in map units 25, 26, 27, 28, 29, and 30; the McKnight soils in map unit 44; and the Shrewder soils in map units 51 and 52 are in this site.

The potential plant community has predominantly a tall and mid grass aspect. The composition by weight is 91 percent grasses, 4 percent forbs, and 5 percent woody plants. Little bluestem, sand bluestem, indiangrass, and switchgrass are preferred plants. They make up 60 percent or more of the forage if range is in excellent condition. As preferred plants disappear under continuous overgrazing, they are replaced by desirable plants, such as sideoats grama, blue grama, tall dropseed, sand paspalum, lovegrasses, skunkbush, and sand sagebrush.

Continuous overgrazing and extreme climatic conditions cause a decline in the desirable plants. If the plant community regresses, undesirable plants, such as sand dropseed, threeawn, mesquite, and annual grasses and forbs dominate the site. As undesirable plants increase, potential forage production is reduced.

Shallow Prairie Range Site

The Acme soils in map units 3 and 4 and the Quinlan soils in map units 49, 69, 70, and 71 are in this site.

The potential plant community has a mid and tall grass aspect. The composition by weight is 95 percent grasses, 4 percent forbs, and 1 percent woody plants. Little bluestem, sand bluestem, and catclaw sensitivebrier are preferrred plants. They make up 20 percent or more of the forage if range is in excellent condition. As preferred plants disappear under continuous overgrazing, they are replaced by desirable plants, such as sideoats, grama, hairy grama, halfshrub sundrop, rushpea, prairie-clover, and scurfpea.

Continuous overgrazing and extreme climatic conditions cause a decline in the desirable plants. As the plant community regresses, undesirable plants, such as hairy tridens, threeawn, plains coreopsis, mesquite, and annual grasses and weeds dominate the site. As undesirable plants increase, potential forage production is reduced.

Subirrigated (saline) Range Site

The Gracemont soils in map unit 18 and the Gracemore soils in map unit 19 are in this site. The surface of this site commonly has wavy microrelief. Difference in elevation of the microrelief ranges from 3 to 8 inches, and the presence of the high and low spots result in some differences in kinds of vegetation.

The potential plant community has a mid and tall grass aspect. The composition by weight is 97 percent grasses, 2 percent forbs, and 1 percent woody plants. Alkali sacaton, switchgrass, vine mesquite, and western wheatgrass are preferred plants. They make up 70 percent or more of the forage if range is in excellent condition. Little bluestem and sand bluestem are preferred and are present, but confined largely to the high islands in the microrelief. As preferred plants disappear under continuous overgrazing, they are replaced by desirable plants, such as inland saltgrass, tall dropseed, blue grama, and buffalograss.

Continuous overgrazing and extreme climatic conditions cause a decline in the desirable plants. If the plant community regresses, undesirable plants, such as whorled dropseed, sumpweed, annual grasses and weeds, baccharis, and saltcedar dominate the site. As undesirable plants increase, potential forage production is reduced.

Very Shallow Range Site

The Talpa soil in map unit 47 is in this site. Areas of this soil are intermingled with many small, barren exposures of underlying limestone.

The potential plant community has a short and mid grass aspect. The composition by weight is 96 percent grasses and 4 percent forbs. Sideoats grama, little bluestem, and sand bluestem are preferred plants. They make up 60 percent or more of the forage if range is in excellent condition. As preferred plants disappear under continuous overgrazing, they are replaced by desirable plants, such as hairy grama, blue grama, halfshrub sundrop, nailwort, prairie-clover, and yucca.

Continuous overgrazing and extreme climatic conditions cause a decline in the desirable plants. If the plant community regresses, undesirable plants, such as hairy tridens, threeawn, mesquite, and annual grasses and weeds dominate the site. As undesirable plants dominate the site, forage production is reduced.

Windbreaks and Environmental Plantings

Norman E. Smola, forester, Soil Conservation Service, helped prepare this section.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

Recreation

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Billy M. Teels, biologist, Soil Conservation Service, helped prepare this section.

Wildlife is fairly abundant throughout Harmon County. Bobwhite quail, doves, rabbits, and coyotes are in all parts of the county. Blue quail are mainly in the southern part but, to a lesser extent, are throughout the county. Deer, beaver, bobcat, raccoon, and wild turkey are common along bottom lands. The wild turkey population is mainly along the Salt Fork of the Red River and its tributaries. Ducks and geese are common in fall and spring.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, tall wheatgrass, lovegrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are skunkbush, Chickasaw plum, sand sagebrush, shinnery oak, sumac, and mesquite.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, saltgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are

created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife predominantly consists of rangeland, pastureland, and cropland. Wildlife use openland for food and other habitat needs. The most critical habitat element is the woody riparian vegetation, which is used by most species of wildlife for some or all of their habitat requirements. It is the habitat element in shortest supply.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, shore birds, muskrat, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include deer, quail, and meadowlark.

Engineering

Charles E. Bollinger, conservation engineer, and Baker B. Eeds, civil engineer, Soil Conservation Service, helped prepare this section.

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to

bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, and shrink-swell potential can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 12 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function

unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain

sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and

depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent.

Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69.

The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, no more than once in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months;

November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An *artesian* water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Physical and Chemical Analyses of Selected Soils

The results of physical analysis of several typical pedons in the survey area are given in table 18 and the results of chemical analysis in table 19. The data are for soils sampled at carefully selected sites. The pedons are typical of the series and are described in the section "Soil Series and Their Morphology." Soil samples were analyzed by the Soil Morphology, Genesis, and Classification Laboratory, Department of Agronomy, Oklahoma State University.

Most determinations, except those for grain-size analysis and bulk density, were made on soil material smaller than 2 millimeters in diameter. Measurements reported as percent or quantity of unit weight were calculated on an oven-dry basis. The methods used in obtaining the data are indicated in the list that follows. The codes in parentheses refer to published methods (*8*).

Sand—(0.05-2.0 mm fraction) weight percentages of materials less than 2 mm (3A1).

Silt—(0.002-0.05 mm fraction) pipette extraction, weight percentages of all materials less than 2 mm (3A1).

Clay—(fraction less than 0.002 mm) pipette extraction, weight percentages of materials less than 2 mm (3A1).

Organic matter—peroxide digestion (6A3).

Extractable cations—ammonium acetate pH 7.0, uncorrected; calcium (6N2), magnesium (6O2), sodium (6P2), potassium (6Q2).

Cation-exchange capacity—sum of cations (5A3a).

Base saturation—sum of cations, TEA, pH 8.2 (5C3).

Reaction (pH)—1:1 water dilution (8C1a).

Total phosphorus—perchloric acid; colorimetry (6S1a).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*9*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 20 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Fluvent (*Fluv*, meaning fluvial or flood plain, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Ustifluvents (*Ust*, meaning combination or Ustic moisture regime, plus *fluvent*, the suborder of the Entisols that have fluvial soil properties).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Ustifluvents.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is coarse-loamy, mixed (calcareous), thermic, Typic Ustifluvents.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*7*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*9*). Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Abilene Series

The Abilene series consists of deep, well drained, nearly level to very gently sloping soils on uplands. These soils formed in predominantly clayey sediment. Permeability is moderately slow. Slope ranges from 0 to 3 percent. The soils of the Abilene series are fine, mixed, thermic Pachic Arguistolls.

Abilene soils commonly are on the landscape with Acme, Altus, Grandfield, Grandmore, Madge, Shrewder, and Vinson soils. All of these soils have less than 35 percent clay in the control section. Grandfield, Grandmore, and Shrewder soils do not have a mollic

epipedon. Acme and Vinson soils are underlain with gypsum.

Typical pedon of Abilene loam in an area of Abilene loam, 0 to 1 percent slopes; 800 feet north and 2,000 feet west of the southeast corner of sec. 16, T. 5 N., R. 25 W.

Ap—0 to 11 inches; brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; slightly hard, friable; few fine and medium roots; mildly alkaline; abrupt smooth boundary.

B21t—11 to 25 inches; brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; very hard, very firm; few fine roots; common distinct clay films on faces of peds; moderately alkaline; clear smooth boundary.

B22t—25 to 38 inches; brown (7.5YR 5/2) clay, brown (7.5YR 4/2) moist; moderate medium subangular blocky structure; very hard, very firm; few fine roots; common distinct clay films on faces of peds; common fine threads and films of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

Cca—38 to 72 inches; light brownish gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; massive; hard, firm; many fine and medium soft calcium carbonate bodies; calcareous; moderately alkaline; gradual smooth boundary.

C—72 to 80 inches; yellowish red (5YR 5/6) loam, yellowish red (5YR 5/6) moist; massive; slightly hard, friable; mildly alkaline.

The thickness of the solum ranges from 28 to 60 inches. Reaction of the A horizon and B21t horizon is mildly alkaline or moderately alkaline.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 2 or 3.

The B21t horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 1 or 2. The B22t horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 1 to 3. The B2t horizon is silty clay loam, clay loam, silty clay, or clay. In some pedons a B23t horizon is present. It has color, texture, and reaction similar to the B22t horizon. A B3 horizon or B3ca horizon is present in some pedons. This horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 2 to 4. It is loam, clay loam, or silty clay loam and is moderately alkaline.

The Cca horizon has hue of 10YR, value of 6 or 7, and chroma of 2 to 6. It is very fine sandy loam, loam, clay loam, and silty clay loam. The C horizon has hue of 5YR to 10YR, value of 5 to 7, and chroma of 1 to 6. This horizon is loam, very fine sandy loam, clay loam, or silty clay loam and is mildly alkaline or moderately alkaline.

Acme Series

The Acme series consists of shallow, well drained, nearly level and very gently sloping soils on uplands. These soils formed in a loamy, soft crystalline gypsiferous material associated with an old river terrace. Permeability is moderate. Slope ranges from 0 to 3 percent. The soils of the Acme series are loamy, mixed, thermic, shallow Entic Haplustolls.

Acme soils commonly are on the landscape with Vinson, Abilene, Tipton, and Westview soils. Vinson soils are intermingled with Acme soils, but they are more than 20 inches in depth and have a cambic horizon. Abilene soils have more than 35 percent clay in the control section and are more than 28 inches in depth. Abilene soils are at a slightly higher elevation than Acme soils. Tipton and Westview soils are more than 60 inches in depth and are at a slightly lower elevation.

Typical pedon of Acme silt loam in an area of Acme-Vinson complex, 0 to 1 percent slopes; 1,600 feet south and 950 feet east of the northwest corner of sec. 31, T. 1 N., R. 24 W.

Ap—0 to 14 inches; brown (7.5YR 4/2) silt loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; slightly hard, friable; many fine roots; many fine pores; common films of calcium carbonate; calcareous; moderately alkaline; abrupt smooth boundary.

C1—14 to 30 inches; white (10YR 8/2) soft crystalline gypsiferous material, pinkish white (7.5YR 8/2) moist; massive; slightly brittle, friable; few to common fine roots; many fine pores; few fine films of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C2—30 to 80 inches; pink (7.5YR 7/4) soft crystalline gypsiferous material, light brown (7.5YR 6/4) moist; massive; slightly brittle, friable; common fine pores; few fine films of calcium carbonate; calcareous in seams; moderately alkaline.

The thickness of the solum ranges from 10 to 20 inches. This soil is typically calcareous throughout.

The A horizon has hue of 7.5YR, value of 4 or 5, and chroma of 2 or 3.

The C horizon has hue of 7.5YR or 10YR, value of 7 or 8, and chroma of 2 to 4. It is soft crystalline gypsiferous material that contains as much as 30 percent soil material. It is typically calcareous, but in the lower part in some pedons is noncalcareous and has seams and coatings of calcium carbonate. The C horizon has a hardness of 2 or less on Mohs' scale.

Altus Series

The Altus series consists of deep, well drained, nearly level and very gently sloping soils on uplands. These soils formed in thick, slightly acid to mildly alkaline, loamy sediment. Permeability is moderate. Slope ranges from 0 to 3 percent. The soils of the Altus series are fine-loamy, mixed, thermic Pachic Argiustolls.

Altus soils are adjacent to the Abilene, Devol, Grandfield, Tipton, and Westview soils on the landscape. Abilene soils have more than 35 percent clay in the control section. Devol and Grandfield soils do not have a mollic epipedon. Tipton soils are loam or clay loam throughout the argillic horizon. Westview soils have less than 15 percent fine sand or coarser material in the control section.

Typical pedon of Altus fine sandy loam in an area of Altus fine sandy loam, 0 to 1 percent; 300 feet north and 2,200 feet west of the southeast corner of sec. 6, T. 2 N., R. 25 W.

Ap—0 to 6 inches; dark brown (7.5YR 4/2) fine sandy loam, dark brown (7.5YR 3/2) moist; weak medium granular structure; hard, friable; neutral; abrupt smooth boundary.

A1—6 to 12 inches; dark reddish brown (5YR 3/2) fine sandy loam, dark reddish brown (5YR 2/2) moist; moderate medium granular structure; soft, friable; common worm casts; neutral; clear smooth boundary.

B1—12 to 21 inches; reddish brown (5YR 4/3) fine sandy loam, dark reddish brown (5YR 3/3) moist; moderate medium subangular blocky structure; hard, firm; common worm casts; mildly alkaline; clear smooth boundary.

B21t—21 to 31 inches; reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; hard, firm; distinct continuous clay films on faces of peds; mildly alkaline; gradual smooth boundary.

B22t—31 to 45 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, firm; continuous clay films on faces of peds; moderately alkaline; clear smooth boundary.

B3—45 to 70 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; soft, friable; thin patchy clay films on faces of peds; moderately alkaline.

The thickness of the solum ranges from 42 to 80 inches. Thickness of the A horizon ranges from 10 to 15 inches.

The A horizon has hue of 5YR to 10YR, value of 3 to 5, and chroma of 2 or 3. It is slightly acid or neutral. The plow layer may be as much as 1 unit higher in value.

The B1 horizon has hue of 5YR or 7.5YR, value of 4, and chroma of 2 or 3. It is neutral or mildly alkaline. The B21t horizon has hue of 5YR, value of 4, and chroma of 2 to 4. It is neutral or mildly alkaline. The B22t horizon has hue of 5YR, value of 4 or 5, and chroma of 3 or 4. It ranges from neutral to moderately alkaline. The B3 horizon has hue of 5YR, value of 5, and chroma of 4. It is fine sandy loam or sandy clay loam. It ranges from neutral to moderately alkaline, and in some pedons below a depth of 48 inches it is calcareous. In some pedons below a depth of 42 to 55 inches, the horizons are dark colored.

Aspermont Series

The Aspermont series consists of moderately deep and deep, well drained, very gently sloping to strongly sloping soils on uplands. These soils formed in loamy alluvial or colluvial material overlying silty Permian red beds. Permeability is moderate. Slope ranges from 1 to 12 percent. The soils of the Aspermont series are fine-silty, mixed, thermic Typic Ustochrepts (fig. 17).

Aspermont soils commonly are on the landscape with Cornick, Hardeman, Knoco, Quanah, Talpa, Tillman, Vernon, and Vinson soils. Cornick, Knoco, and Talpa soils are less than 20 inches in depth. Quanah soils have a mollic epipedon. Tillman soils have a mollic epipedon and have more than 35 percent clay in the control section. Vernon soils have more than 35 percent clay in the control section and have shale within a depth of 40 inches. Vinson soils have gypsum at a depth of 20 to 40 inches. Hardeman soils have less than 18 percent clay in the control section.

Typical pedon of Aspermont silt loam in an area of Aspermont silt loam, 1 to 3 percent slopes; about 1,600 feet south and 50 feet west of the northeast corner of sec. 7, T. 1 N., R. 25 W.

Ap—0 to 7 inches; reddish brown (5YR 5/4) silt loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; hard, friable; many fine roots; few worm casts; calcareous; moderately alkaline; abrupt smooth boundary.

A1—7 to 14 inches; reddish brown (5YR 4/4) silt loam, dark reddish brown (5YR 3/4) moist; moderate fine and medium granular structure; hard, friable; many fine roots; few fine pores; few thin films and few fine concretions of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B21—14 to 21 inches; yellowish red (5YR 4/6) silt loam, dark reddish brown (5YR 3/4) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, firm; few fine roots; many worm casts; few thin films and few fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

B22—21 to 29 inches; yellowish red (5YR 4/6) silt loam, dark red (2.5YR 3/6) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, firm; few fine roots; few worm casts; few films and threads and common fine concretions of calcium carbonate; calcareous; moderately alkaline; abrupt wavy boundary.

B3ca—29 to 38 inches; reddish brown (2.5YR 4/4) silty loam, dark reddish brown (2.5YR 3/4) moist; weak coarse prismatic structure parting to weak fine

Figure 17.—Profile of Aspermont silt loam. Accumulations of secondary calcium carbonate as concretions, coatings, and soft masses are in the subsoil.

subangular blocky; hard, firm; few fine roots; few worm casts; many medium and fine concretions and many soft bodies of calcium carbonate; few fragments of dolomitic limestone and shale; calcareous; moderately alkaline; clear wavy boundary.

Cca—38 to 41 inches; red (2.5YR 4/6) silt loam, dark red (2.5YR 3/6) moist; massive; hard, firm; few thin (1/2" thick) strata of dolomitic limestone; few fragments of shale; 40 percent by volume visible calcium carbonate in the form of common medium and fine concretions and soft bodies; calcareous; moderately alkaline; clear wavy boundary.

Cr—41 to 80 inches; gray (5Y 5/1) and weak red (10R 4/3) alternating beds of shale that contain thin strata of dolomitic limestone; fractures in shale are coated with calcium carbonate; the underside of the limestone is coated with calcium carbonate; moderately alkaline.

The thickness of the solum ranges from 24 to 60 inches, and depth to soft bedrock is 40 to 60 inches. This soil is mainly moderately alkaline and calcareous throughout, but in a few areas it is noncalcareous and moderately alkaline in the A horizon.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4.

The B2 horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 3 to 6. It is silty clay loam, silt loam, or clay loam. The B2 horizon is 1 to 15 percent by volume secondary carbonates in the form of soft bodies, films, threads, and concretions. The B3ca horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 or 6. It is silt loam, clay loam, or silty clay loam. This horizon is 2 to 30 percent by volume secondary carbonates in the form of threads, concretions, and soft bodies.

The Cca horizon has hue of 2.5YR and 5YR, value of 4 to 6, and chroma of 4 to 6. It is silt loam, clay loam, or silty clay loam. The accumulation of calcium carbonate in the Cca horizon ranges from a few films and threads to about 40 percent by volume. The Cr horizon is red and gray shale that is moderately alkaline.

Beckman Series

The Beckman series consists of deep, well drained, nearly level soils on flood plains. These soils dominantly formed in recent calcareous and saline clayey alluvium. Permeability is very slow. Slope is 0 to 1 percent. The soils of the Beckman series are fine, mixed (calcareous), thermic Vertic Ustifluvents.

Beckman soils are commonly adjacent to Mangum and Spur soils on the landscape. Mangum soils are in slightly higher lying areas than the Beckman soils and have a cambic horizon. Spur soils are along the stream channels, have a mollic epipedon, and have less than 35 percent clay in the control section.

Typical pedon of Beckman silty clay in an area of Beckman silty clay, occasionally flooded; 2,300 feet west and 1,000 feet south of the northeast corner of sec. 35, T. 3 N., R. 24 W.

A1—0 to 11 inches; reddish brown (5YR 4/4) silty clay, dark reddish brown (5YR 3/4) moist; moderate fine and medium granular structure; extremely hard, very

firm; many fine and medium roots; calcareous; mildly alkaline; clear smooth boundary.

C1—11 to 20 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; massive; extremely hard, very firm; common fine roots; common thin distinct bedding planes; few loamy strata; calcareous; mildly alkaline; clear smooth boundary.

C2—20 to 44 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; massive; very hard, very firm; few fine roots; few thin faint bedding planes; few fine salt crystals; many fine threads of calcium carbonate; calcareous; mildly alkaline; clear smooth boundary.

C3—44 to 80 inches; reddish brown (2.5YR 5/4) silty clay, reddish brown (2.5YR 4/4) moist; massive; very hard, very firm; seams of gypsum and salt crystals; few fine black bodies; calcareous; mildly alkaline.

The A horizon has hue of 5YR, value of 4 or 5, and chroma of 3 or 4. Electrical conductivity of the saturation extract ranges from 2 to 8 millimhos per centimeter.

The C horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 6. It is clay or silty clay and has few to many thin strata of silt loam and silty clay loam. The C horizon is mildly alkaline or moderately alkaline and contains few to common threads, films, and concretions of calcium carbonate. It contains few to many salt crystals and gypsum crystals. Electrical conductivity of the saturation extract ranges from 4 to 12 millimhos per centimeter.

Carey Series

The Carey series consists of deep, well drained, very gently sloping soils on uplands. These soils formed in weakly consolidated sandstone of the Permian red beds. Permeability is moderate. Slope ranges from 1 to 3 percent. The soils of the Carey series are fine-silty, mixed, thermic Typic Argiustolls.

Carey soils are on the landscape with Madge, Quinlan, and Woodward soils. Madge soils have more than 15 percent fine sand or coarser in the control section. Quinlan and Woodward soils have less than 18 percent clay in the control section and have an ochric epipedon.

Typical pedon of Carey loam in an area of Carey loam, 1 to 3 percent slopes; 1,500 feet west and 150 feet south of the northeast corner of sec. 21, T. 5 N., R. 26 W.

Ap—0 to 5 inches; reddish brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; weak medium granular structure; soft, very friable; many fine roots; mildly alkaline; abrupt smooth boundary.

A1—5 to 15 inches; reddish brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; moderate medium granular structure; soft, very friable; many fine roots; mildly alkaline; clear smooth boundary.

B21t—15 to 24 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, firm; common fine roots; common distinct clay films on faces of peds; moderately alkaline; gradual smooth boundary.

B22t—24 to 42 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist: weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, firm; common fine roots; common distinct clay films on faces of peds; few fine threads and films of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B3ca—42 to 65 inches; reddish yellow (5YR 6/6) loam, yellowish red (5YR 5/6) moist; moderate coarse subangular blocky structure; slightly hard, firm; few fine roots; common fine and medium concretions and many medium soft bodies of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

Cr—65 to 80 inches; red (2.5YR 5/6) soft weakly consolidated sandstone, red (2.5YR 4/6) moist; moderately alkaline.

The thickness of the solum ranges from 40 to 70 inches. Reaction is neutral or mildly alkaline in the A horizon and ranges from neutral to moderately alkaline in the B2t horizon. The depth to secondary carbonates ranges.from 11 to 30 inches.

The A horizon has hue of 5YR, value or 4, and chroma of 3.

The B2t horizon has hue of 5YR, value of 4 or 5, and chroma of 4 to 6. It is loam, silty clay loam, or clay loam and ranges from 18 to 35 percent clay. In some pedons, this horizon contains soft calcium carbonate bodies or concretions. The B3ca horizon has hue of 5YR, value of 5 or 6, and chroma of 6.

The Cr horizon has hue of 2.5YR, value of 5, and chroma of 6. It is soft, weakly consolidated sandstone and is moderately alkaline.

Clairemont Series

The Clairemont series consists of deep, well drained, nearly level soils on flood plains. These soils formed in loamy calcareous alluvium. Permeability is moderate. Slope is mainly less than 1 percent. The soils of the Clairemont series are fine-silty, mixed (calcareous), thermic Typic Ustifluvents.

Clairemont soils commonly are on the landscape with Gracemont, Mangum, Spur, and Yahola soils. Gracemont soils have more than 15 percent material coarser than very fine sand in the control setion and have a water table above a depth of 40 inches during most of the year. Mangum soils have more than 35 percent clay in

the control section. Spur soils have a mollic epipedon. Yahola soils have less than 18 percent clay and more than 15 percent material coarser than very fine sand in the control section.

Typical pedon of Clairemont silt loam in an area of Clairemont silt loam, occasionally flooded; 2,100 feet north and 2,200 feet east of the southwest corner of sec. 33, T. 6 N., R. 26 W.

A1—0 to 7 inches; reddish brown (5YR 5/4) silt loam, dark reddish brown (5YR 3/4) moist; moderate medium granular structure; hard, friable; many fine and medium roots; calcareous; moderately alkaline; clear smooth boundary.

C1—7 to 16 inches; reddish brown (5YR 5/4) silt loam, dark reddish brown (5YR 3/4) moist; massive; hard, friable; many fine and medium roots; common worm casts; few thin strata of very fine sandy loam and sandy loam; calcareous; moderately alkaline; clear smooth boundary.

C2—16 to 36 inches; reddish brown (5YR 5/4) silt loam, reddish brown (5YR 4/4) moist; massive; hard, friable; common fine roots; common worm casts; few thin strata of very fine sandy loam and sandy loam; pockets of decomposed plant material; calcareous; moderately alkaline; clear smooth boundary.

C3—36 to 80 inches; reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; massive; hard, friable; few fine roots; few thin strata of fine sandy loam and silt loam; common fine bodies of calcium carbonate; calcareous; moderately alkaline.

This soil is typically calcareous throughout. Thickness of the A horizon ranges from 7 to 14 inches.

The A horizon has hue of 2.5YR to 7.5YR, value of 4 or 5, and chroma of 4 to 6.

The C horizon has colors similar to those of the A horizon. It is silt loam or loam. Bedding planes range from faint to prominent.

A buried horizon is in some pedons.

Cornick Series

The Cornick series consists of very shallow, well drained, very gently sloping to gently sloping soils on convex slopes on uplands. These soils formed in material weathered from impure gypsum of Permian age. Permeability is moderate. Slope is dominantly 1 to 5 percent. The soils of the Cornick series are loamy, mixed, thermic, shallow Entic Haplustolls.

Cornick soils commonly are on the landscape with Aspermont, Knoco, Quanah, Talpa, Vernon, and Vinson soils. Aspermont soils are generally in higher lying convex areas than Cornick soils, their solum is more than 20 inches thick, and they do not have a mollic epipedon. Quanah soils are generally on the higher lying ridgetops and have a solum more than 20 inches thick. Knoco and Vernon soils have more than 35 percent clay and are underlain with shale or clayey sediment. Talpa soils are underlain with hard limestone. Vinson soils are more than 20 inches thick over gypsum.

Typical pedon of Cornick silt loam in an area of Cornick-Vinson-Rock outcrop complex, 1 to 5 percent slopes; 4,500 feet east and 300 feet north of the southwest corner of sec. 8, T. 6 N., R. 26 W.

A1—0 to 5 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; hard, friable; calcareous; moderately alkaline; clear smooth boundary.

C1—5 to 10 inches; pinkish white (5YR 8/2) soft weathered gypsum; massive; films of calcium carbonates in cracks; noncalcareous in matrix; moderately alkaline; abrupt wavy boundary.

Cr—10 to 15 inches; white (5YR 8/1) gypsum; noncalcareous in matrix, calcareous films in cracks.

The thickness of the solum and the depth to gypsum bedrock is 5 to 10 inches.

The A horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 or 3.

The C1 horizon is pinkish white or pink, weathered gypsum or in some pedons is mixed loamy calcareous materials and weathered gypsum. It ranges from 0 to 8 inches in thickness. The Cr horizon is white gypsum of paralithic consolidation that can be easily chipped or scratched with a knife or spade.

Devol Series

The Devol series consists of deep, well drained, nearly level to strongly sloping soils on sandy or loamy uplands. These soils formed in deep sandy eolian sediment or in alluvial sediment reworked by wind. Permeability is moderately rapid. Slope ranges from 0 to 12 percent. The soils of the Devol series are coarse-loamy, mixed, thermic Udic Haplustalfs (fig. 18).

Devol soils are similar to Grandfield soils and commonly are on the landscape with Altus, Grandfield, Grandmore, Hardeman, McKnight, Nobscot, Likes, and Tivoli soils. Altus soils have a mollic epipedon and have more than 18 percent clay in the upper 20 inches of the subsoil. Nobscot soils have a surface layer of fine sand more than 20 inches thick. Tivoli and Likes soils have loamy fine sand or coarser in the control section and do not have an argillic horizon. Grandfield, Grandmore, and McKnight soils have more than 18 percent clay in the B2t horizon. Hardeman soils do not have an argillic horizon.

Typical pedon of Devol loamy fine sand in an area of Devol loamy fine sand, 0 to 3 percent slopes; 200 feet north and 100 feet east of the southwest corner of sec. 14, T. 4 N., R. 26 W.

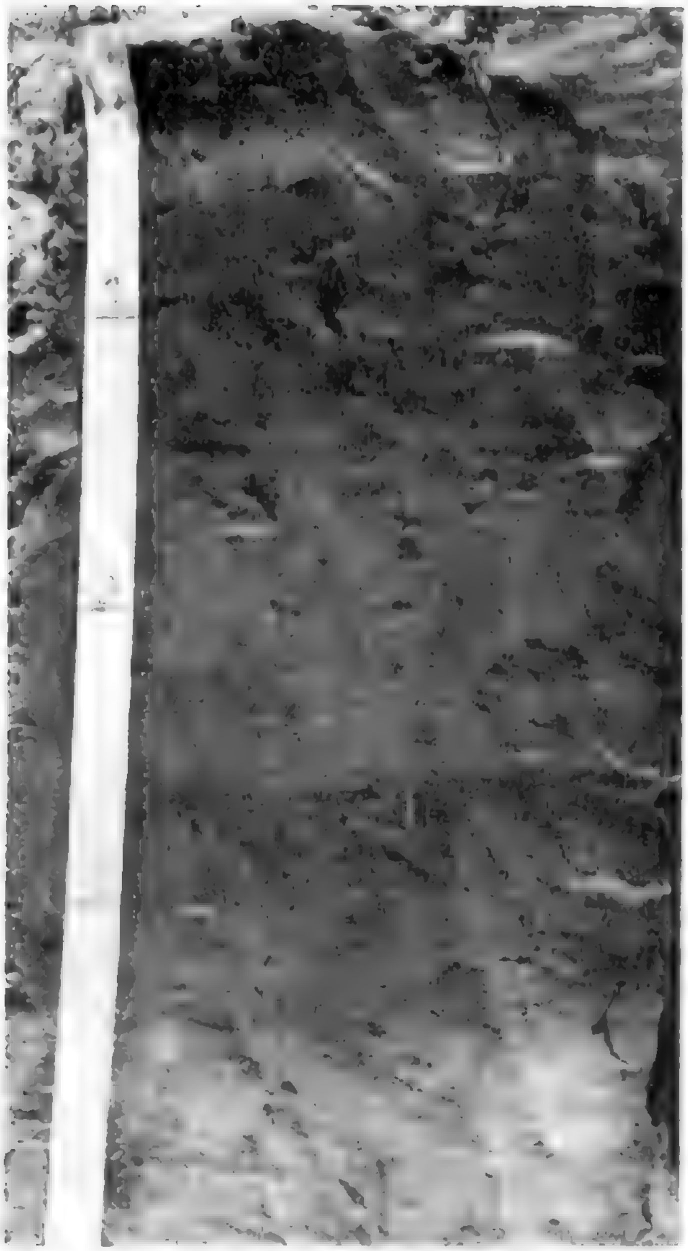


Figure 18.—Profile of Devol loamy fine sand. The scale is in feet.

Ap—0 to 12 inches; reddish brown (5YR 5/4) loamy fine sand, reddish brown (5YR 4/4) moist; weak fine granular structure; loose, very friable; few fine roots; neutral; abrupt smooth boundary.

B21t—12 to 21 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak fine prismatic structure parting to weak fine subangular blocky; slightly hard, friable; few fine roots; few worm casts; common thin clay films on faces of peds; neutral; gradual smooth boundary.

B22t—21 to 35 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak fine prismatic structure parting to weak fine subangular blocky; slightly hard, very friable; few fine roots; few thin clay films on faces of peds; clay bridging between sand grains; neutral; gradual smooth boundary.

B3—35 to 44 inches; yellowish red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6) moist; weak coarse prismatic structure; loose, very friable; few fine roots; few pockets of clean sand; neutral; gradual smooth boundary.

C—44 to 80 inches; yellowish red (5YR 5/8) loamy fine sand, yellowish red ((5YR 4/6) moist; single grained; loose; few pockets of clean sand; neutral.

The thickness of the solum ranges from 30 to 60 inches. In the less sloping areas, a buried profile is common below a depth of 50 inches.

The A horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 2 to 6. It is loamy fine sand or fine sandy loam and is slightly acid to mildly alkaline.

The B2t horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 4 to 6. It is fine sandy loam and averages between 8 and 18 percent clay content. This horizon is neutral to mildly alkaline. The B3 horizon has hue of 2.5YR to 7.5YR, value of 5 to 6, and chroma of 4 to 6. It is loamy fine sand or fine sandy loam and is neutral to moderately alkaline.

The C horizon has hue of 2.5YR to 7.5YR, value of 5 to 7, and chroma of 4 to 8. It is loamy sand, loamy fine sand, or fine sandy loam and is neutral to moderately alkaline. In some pedons this horizon is calcareous below a depth of 40 inches.

Gracemont Series

The Gracemont series consists of deep, somewhat poorly drained, nearly level soils on flood plains. These soils formed in loamy calcareous alluvium. A water table is at a depth of 1/2 foot to 3 1/2 feet during winter and spring. Permeability is moderate to moderately rapid. Slope is 0 to 1 percent. The soils of the Gracemont series are coarse-loamy, mixed (calcareous), thermic Aquic Udifluvents.

Gracemont soils are similar to Yahola soils and commonly are near Clairemont, Gracemore, Likes, Lincoln, and Yahola soils on the landscape. Clairemont soils have more than 18 percent clay in the 10- to 40-inch control section. Gracemore, Likes, and Lincoln soils have a horizon of fine sand or loamy fine sand below a depth of 10 inches. Yahola and Lincoln soils are dry for longer periods and do not have a water table above a depth of 40 inches. Likes soils are not flooded.

Typical pedon of Gracemont fine sandy loam in an area of Gracemont fine sandy loam, saline, frequently flooded; 3,400 feet west and 440 feet north of the southeast corner of sec. 3, T. 4 N., R. 26 W.

A1—0 to 14 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak fine granular structure; hard, friable; many fine and medium roots; calcareous; moderately alkaline; clear smooth boundary.

C—14 to 80 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; massive; hard, friable; common fine roots; few thin strata of brown and light brown silt loam, loam, and loamy fine sand; strata 1/8 inch to 2 inches thick; water table at a depth of 3 feet; few fine salt crystals above the water table; calcareous; moderately alkaline.

These soils are moderately alkaline and are calcareous throughout. They are moderately affected by saline salts which occur as a white crust on the soil surface and as salt crystals in the solum. The seasonal high water table is at a depth of 6 to 40 inches from November to May but is lower from June to October. In some pedons a buried horizon is below a depth of 40 inches.

The thickness of the A horizon ranges from 6 to 14 inches. The A horizon has hue of 5YR to 10YR, value of 5 or 6, and chroma of 2 to 4. Electrical conductivity of the saturation extract ranges from 4 to 16 millimhos per centimeter.

The C horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 4 to 6. It is fine sandy loam and has strata of loam, silt loam, silty clay loam, or loamy fine sand. Electrical conductivity of the saturation extract ranges from 4 to 8 millimhos per centimeter.

Gracemore Series

The Gracemore series consists of deep, somewhat poorly drained, nearly level soils on flood plains. These soils predominantly formed in calcareous and saline sandy alluvium. A water table is at a depth of 1/2 foot to 3 1/2 feet during winter and spring. Permeability is moderately rapid. Slope is 0 to 1 percent. The soils of the Gracemore series are sandy, mixed, thermic, Aquic Udifluvents.

Gracemore soils commonly are on the landscape with Gracemont, Likes, Lincoln, and Yahola soils. Gracemont soils have a fine sandy loam horizon below a depth of 10 inches. Lincoln soils do not have a water table at a depth of 40 inches or less most of the year. Yahola soils are dry for longer periods than Gracemore soils, do not have a water table at a depth of 40 inches or less, and have a fine sandy loam or loam horizon below a depth of 10 inches. Lincoln and Yahola soils are slightly higher on the landscape than Gracemore soils and are better drained. Likes soils are not flooded and do not have a water table at a depth of 40 inches or less.

Typical pedon of Gracemore loam in an area of Gracemore loam, saline, frequently flooded; 2,000 feet east and 900 feet south of the northwest corner of sec. 7, T. 1 N., R. 26 W.

A1—0 to 12 inches; light reddish brown (5YR 6/4) loam, reddish brown (5YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, very friable; common fine salt crystals and salt crust on surface; calcareous; moderately alkaline; clear smooth boundary.

C—12 to 80 inches; light brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 5/4) moist; single grained; loose; few fine roots; few thin strata of yellowish red fine sandy loam; evident bedding planes; few fine salt crystals; calcareous; moderately alkaline.

These soils are typically calcareous and are moderately alkaline throughout. They are moderately affected by saline salts which occur as a white crust on the soil surface and as salt crystals in the solum. The seasonal high water table is at a depth of 6 to 36 inches from November to May but is lower from June to October.

The thickness of the A horizon ranges from 6 to 14 inches. The A horizon has hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 2 to 6. The electrical conductivity of the saturation extract ranges from 4 to 16 millimhos per centimeter.

The C horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 4. It is fine sand or loamy fine sand but has few to many bedding planes of finer textured material. Electrical conductivity of the saturation extract ranges from 4 to 8 millimhos per centimeter.

Grandfield Series

The Grandfield series consists of deep, well drained, nearly level to gently sloping soils on broad uplands. These soils formed in eolian deposits or in old alluvium that has been reworked by wind. Permeability is moderate. Slope ranges from 0 to 5 percent. The soils of the Grandfield series are fine-loamy, mixed, thermic Udic Haplustalfs.

Grandfield soils commonly are on the landscape with Abilene, Altus, Devol, Grandmore, McKnight, Nobscot, and Tipton soils. Abilene soils have a mollic epipedon and have more than 35 percent clay in the control section. Altus and Tipton soils have a mollic epipedon. Devol soils have less than 18 percent clay in the control section. Nobscot soils are less clayey in the argillic horizon and have an A horizon of fine sand more than 20 inches thick. Grandmore soils are underlain with a dark buried soil at a depth of 30 to 50 inches. McKnight

soils are underlain with Permian shale and sandstone at a depth of 30 to 50 inches.

Typical pedon of Grandfield loamy fine sand in an area of Grandfield loamy fine sand, 0 to 3 percent slopes; 2,600 feet south and 250 feet west of the northeast corner of sec. 8, T. 3 N., R. 25 W.

Ap—0 to 7 inches; light brown (7.5YR 6/4) loamy fine sand, dark brown (7.5YR 4/4) moist; single grained; loose; common fine roots; neutral; abrupt smooth boundary.

A1—7 to 15 inches; brown (7.5YR 5/4) loamy fine sand, dark brown (7.5YR 4/4) moist; single grained; loose; common fine roots; neutral; clear smooth boundary.

B1—15 to 24 inches; reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak medium prismatic structure; hard, friable; common fine roots; few patchy clay films on faces of peds; exterior of peds is dark reddish brown (5YR 3/3); neutral; gradual smooth boundary.

B21t—24 to 38 inches; reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; moderate medium prismatic structure; hard, firm; common fine roots; thin continuous clay films on faces of peds; neutral; gradual smooth boundary.

B22t—38 to 58 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate medium distinct dark red (2.5YR 3/6) mottles; moderate coarse prismatic structure; hard, firm; few fine roots; thick continuous clay films on faces of peds; few fine water rounded pebbles; neutral; gradual smooth boundary.

B23t—58 to 68 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; common medium distinct dark red (2.5YR 3/6) mottles; moderate coarse prismatic structure; hard, firm; few fine roots along cracks between peds; common fine pores; thick continuous clay films; exterior of peds is dark reddish brown (5YR 3/4); few black stains; few water rounded pebbles; neutral; gradual smooth boundary.

B3—68 to 80 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; moderate medium prismatic structure; hard, firm; few fine roots along cracks between peds; few clay films on faces of peds; exterior of peds is dark reddish brown (5YR 3/4); few spots of clean sand grains; few water rounded pebbles; neutral.

The thickness of the solum ranges from 50 to 80 inches or more. Thickness of the surface layer ranges from 4 to 19 inches.

The A horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. It is fine sandy loam or loamy fine sand and is slightly acid to mildly alkaline.

The B1 horizon, where present, has hue of 5YR, value of 4 to 6, and chroma of 3 to 6. It is fine sandy loam or sandy clay loam and is slightly acid to mildly alkaline.

The B2t horizon has hue of 2.5YR or 5YR, value of 4 to 7, and chroma of 3 to 8. It is sandy clay loam or fine sandy loam. The upper part of this horizon is slightly acid to mildly alkaline and the lower part is neutral to moderately alkaline. The B3 horizon has colors similar to those of the B2t horizon and is fine sandy loam or sandy clay loam. This horizon is neutral to moderately alkaline.

The C horizon, where present, has colors similar to those of the B3 horizon but includes hue of 7.5YR. The C horizon is fine sandy loam to loamy fine sand and has reaction similar to the B3 horizon. In some pedons, the C horizon is calcareous.

Grandmore Series

The Grandmore series consists of deep, moderately well drained, nearly level to very gently sloping soils on high terraces. These soils formed in loamy sediment over calcareous loamy and clayey buried soils of Pleistocene age. Permeability is moderately slow. Slope ranges from 0 to 3 percent but generally is less than 2 percent. The soils of the Grandmore series are fine-loamy, mixed, thermic, Udic Haplustalfs.

Grandmore soils commonly are on the landscape with Abilene, Devol, Grandfield, and McKnight soils. Abilene soils are in slightly concave areas and have more than 35 percent clay content in the control section. Devol soils are on adjacent side slopes and have less than 18 percent clay content in the control section. Grandfield soils are on adjacent slopes and do not have a buried horizon below a depth of 30 inches. McKnight soils have a solum 30 to 50 inches thick over Permian shales and sandstone.

Typical pedon of Grandmore loamy fine sand in an area of Grandmore loamy fine sand, 0 to 3 percent slopes; 400 feet west and 2,600 feet south of the northeast corner of sec. 13, T. 4 N., R. 27 W.

Ap—0 to 12 inches; brown (7.5YR 5/2) loamy fine sand, dark brown (7.5YR 4/2) moist; weak medium granular structure; soft, friable; common fine and medium roots; neutral; clear smooth boundary.

A1—12 to 18 inches; brown (7.5YR 5/2) loamy fine sand, dark brown (7.5YR 4/2) moist; moderate medium granular structure; soft, friable; common fine and medium roots; neutral; clear smooth boundary.

B21t—18 to 31 inches; reddish gray (5YR 5/2) sandy clay loam, dark reddish gray (5YR 4/2) moist; moderate fine and medium subangular blocky structure; hard, firm; common fine roots; thick continuous clay films on faces of peds; mildly alkaline; clear smooth boundary.

IIB22tb—31 to 54 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; common medium distinct brownish yellow (10YR 6/6) and gray (10YR 6/1) mottles: moderate medium subangular blocky structure; very hard, very

firm; common fine roots; thick continuous clay films on faces of peds; mildly alkaline; gradual smooth boundary.

IIB3b—54 to 80 inches; light gray (10YR 7/1) clay loam, gray (10YR 5/1) moist; common medium distinct yellowish brown (10YR 5/4), very pale brown (10YR 7/3), and brown (7.5YR 4/4) mottles; weak coarse subangular blocky structure; very hard, very firm; few fine roots; few seams of calcium carbonates; calcareous; moderately alkaline.

The thickness of the solum is more than 60 inches. Depth to the IIB22tb horizon ranges from 30 to 50 inches. This soil does not have an abrupt textural change between the B21t and IIB22tb horizons. Gray colors in the upper part of the argillic horizon and mottles in the IIB22tb and IIB3b horizons are attributed to a past moisture regime and are not believed to indicate present wetness.

The A horizon has hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 2 to 4. It is neutral to moderately alkaline.

The B2t horizon has hue of 5YR, value of 4 to 6, and chroma of 2 to 6. It is sandy clay loam or fine sandy loam and is mildly alkaline or moderately alkaline. A B3 horizon is in some pedons. It has color, texture, and reaction similar to those of the B2t horizon.

The IIB22tb horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 1 to 6. It is clay loam or clay and is mildly alkaline or moderately alkaline. The IIB3b horizon has hue of 5YR to 10YR, value of 5 to 7, and chroma of 1 to 6. It is clay loam or clay.

Hardeman Series

The Hardeman series consists of deep, well drained, very gently sloping to strongly sloping soils on uplands. These soils formed in mostly calcareous loamy eolian material. Permeability is moderately rapid. Slope ranges from 1 to 12 percent. The soils of the Hardeman series are coarse-loamy, mixed, thermic Typic Ustochrepts.

Hardeman soils are similar to Woodward soils and commonly are on the landscape with Aspermont, Devol, Likes, Tipton, Tivoli, and Woodward soils. Devol soils are noncalcareous throughout and have an argillic horizon. Aspermont soils have more than 18 percent clay in the control section. Likes and Tivoli soils are generally on higher narrow ridges than Hardeman soils. Likes soils have horizons of loamy fine sand or coarser throughout the control section, and Tivoli soils have fine sand or sand throughout the control section. Tipton soils have a mollic epipedon and have an argillic horizon. Woodward soils have less than 15 percent material coarser than very fine sand in the control section and are underlain with sandstone at a depth of 20 to 40 inches.

Typical pedon of Hardeman fine sandy loam in an area of Hardeman fine sandy loam, 1 to 3 percent slopes; 2,800 feet north and 350 feet west of the southeast corner of sec. 4, T. 4 N., R. 26 W.

Ap—0 to 9 inches; reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; slightly hard, friable; few fine roots; mildly alkaline; clear smooth boundary.

B2—9 to 27 inches; reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; slightly hard, friable; few fine roots; mildly alkaline; gradual smooth boundary.

B3—27 to 46 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak coarse subangular blocky structure; slightly hard, friable; few fine threads of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C—46 to 80 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; massive; soft, friable; calcareous; moderately alkaline.

The thickness of the solum ranges from 30 to 50 inches. The depth to secondary carbonates is 14 to 34 inches.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is mildly alkaline or moderately alkaline.

The B2 horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 4 to 6. It is mildly alkaline or moderately alkaline in the upper part and moderately alkaline and calcareous in the lower part. The B3 horizon has hue of 2.5YR or 5YR, value of 5 or 6, and chroma of 4 to 8.

The C horizon is similar to the B3 horizon in color, texture, and reaction. It is moderately alkaline and is calcareous.

Hollister Series

The Hollister series consists of deep, well drained, nearly level soils on broad smooth uplands. These soils formed in mostly calcareous clayey sediment over Permian age clay or shale. Permeability is slow. Slope is 0 to 1 percent. The soils of the Hollister series are fine, mixed, thermic Pachic Paleustolls.

Hollister soils commonly are on the landscape with Tillman and Vernon soils. Tillman soils have a mollic epipedon less than 20 inches thick. Vernon soils do not have a mollic epipedon and have a solum less than 40 inches thick.

Typical pedon of Hollister silty clay loam in an area of Hollister silty clay loam, 0 to 1 percent slopes; 100 feet south and 2,150 feet west of the northeast corner of sec. 32, T. 2 N., R. 24 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate fine subangular blocky structure; hard, friable; few fine roots; mildly alkaline; abrupt smooth boundary.

B21t—6 to 21 inches; very dark grayish brown (10YR 3/2)silty clay loam, very dark brown (10YR 2/1) moist; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; hard, firm; few fine roots; distinct nearly continuous clay films on faces of peds; few very fine calcium carbonate concretions; calcareous; moderately alkaline; gradual smooth boundary.

B22t—21 to 35 inches; dark grayish brown (10YR 4/2) clay, very dark brown (10YR 2/2) moist; moderate medium prismatic structure parting to moderate medium blocky; very hard, very firm; few fine roots; distinct nearly continuous clay films on faces of peds; few fine calcium carbonate concretions; calcareous; moderately alkaline; gradual smooth boundary.

B23t—35 to 55 inches; brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; moderate medium prismatic structure parting to moderate medium blocky; very hard, very firm; distinct patchy clay films on faces of peds; few fine calcium carbonate concretions; calcareous; moderately alkaline; gradual smooth boundary.

B24t—55 to 70 inches; reddish brown (5YR 5/3) clay, reddish brown (5YR 4/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; very hard, very firm; distinct patchy clay films on faces of peds; few fine calcium carbonate concretions; calcareous; moderately alkaline; gradual smooth boundary.

B3—70 to 80 inches; yellowish red (5YR 5/6) silty clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; very hard, very firm; few fine calcium carbonate concretions; calcareous; moderately alkaline.

The thickness of the solum is more than 60 inches.

The A horizon ranges from 10 to 14 inches in thickness. It has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 2. This horizon has clay content of 27 to 35 percent. It is mildly alkaline or moderately alkaline.

The B21t horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 2. It is mildly alkaline or moderately alkaline and is silty clay loam or clay. This horizon has clay content of 35 to 45 percent. The B22t horizon or B23t horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 to 4. It is silty clay loam or clay. This horizon has clay content of 35 to 50 percent. The B24t horizon has hue of 5YR or 7.5YR, value of 5, and chroma of 2 or 3. It is clay, clay loam, or silty clay loam. The B3 horizon has hue of 5YR, value of 5, and chroma of 6. It is silty clay, clay loam, or clay.

The C horizon, where present, has hue of 2.5YR or 5YR, value of 5 or 6, and chroma of 6. It is calcareous, moderately alkaline clay or shaly clay.

Knoco Series

The Knoco series consists of very shallow, well drained to excessively drained, gently sloping to steep soils on uplands. These soils formed in shales and clayey red-bed sediment of Permian age. Permeability is very slow. Slope ranges from 3 to 40 percent. The soils of the Knoco series are clayey, mixed (calcareous), thermic, shallow Ustic Torriorthents.

The Knoco soils commonly are adjacent on the landscape to Aspermont, Cornick, Talpa, Vinson, and Vernon soils. Aspermont soils are more than 20 inches deep and have less than 35 percent clay in the control section. Cornick and Vinson soils are underlain by gypsum and have a mollic epipedon. Talpa soils are underlain by dolomitic limestone and have a mollic epipedon. Vernon soils have a solum 20 to 40 inches thick.

Typical pedon of Knoco clay in an area of Knoco-Rock outcrop complex, 20 to 40 percent slopes; 1,920 feet east and 3,500 feet north of the southwest corner of sec. 9, T. 6 N., R. 26 W.

A1—0 to 6 inches; red (2.5YR 5/6) clay, red (2.5YR 4/6) moist; weak fine subangular blocky structure; hard, firm; many fine roots; calcareous; moderately alkaline; clear smooth boundary.

Cr—6 to 20 inches; red (2.5YR 4/6) clayey shale, dark red (2.5YR 3/6) moist; massive; very hard, very firm; few fine roots in cracks of shale; calcareous; moderately alkaline.

The thickness of the solum and the depth to red-bed shale range from 3 to 12 inches. The soil is moderately alkaline throughout and is calcareous.

The A1 horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. Texture is clay or silty clay. Content of coarse fragments ranges from 0 to 15 percent, by volume.

The Cr horizon is red, gray, or bluish-green gypsiferous shale or clayey shale. It is weakly consolidated to massive. In some pedons, the horizon has crystals, granules, or thin horizontal strata of gypsum.

Likes Series

The Likes series consists of deep, excessively drained, hummocky soils. These soils formed in sandy aeolian sediment on flood plains and in water-lain sediment adjacent to uplands. Permeability is rapid. Slope is dominantly 3 to 8 percent but ranges to 12 percent. The soils of the Likes series are mixed, thermic Typic Ustipsamments.

Likes soils commonly are on the landscape with Devol, Gracemont, Gracemore, Hardeman, Lincoln, Tivoli, and Yahola soils. Devol and Hardeman soils have a weighted average texture finer than loamy fine sand in the control section. Gracemont and Gracemore soils have a water table within a depth of 40 inches during part of the year. Lincoln and Yahola soils formed in recent alluvial sediment and in addition, the Yahola soils have a weighted average texture finer than loamy fine sand in the control section. Tivoli soils are at a higher elevation than Likes soils and are calcareous within a depth of 13 to 40 inches.

Typical pedon of Likes fine sand in an area of Likes fine sand, hummocky; 1,800 feet east and 1,800 feet south of the northwest corner of sec. 16, T. 4 N., R. 25 W.

A—0 to 6 inches; reddish yellow (5YR 6/6) fine sand, yellowish red (5YR 5/6) moist; single grained; loose; common fine roots; calcareous; moderately alkaline; clear smooth boundary.

C—6 to 80 inches; reddish yellow (7.5YR 7/6) fine sand, reddish yellow (7.5YR 6/6) moist; single grained; loose; few fine roots; common thin crossbedded strata throughout; calcareous; moderately alkaline.

The depth of the soil is more than 60 inches. This soil is moderately alkaline and typically calcareous throughout, but some pedons may be noncalcareous to a depth of 10 inches.

The A horizon has hue of 5YR, value of 5 to 7, and chroma of 3 to 6. It is gravelly loamy fine sand or fine sand and has less than 1 percent organic matter content.

The C horizon has hue of 5YR or 7.5YR, value of 5 to 7, and chroma of 4 to 6. It is fine sand, loamy fine sand, or sand and has common, thin crossbedding in strata. In some pedons, gravel makes up about 15 percent by volume of this horizon.

Lincoln Series

The Lincoln series consists of deep, somewhat excessively drained, nearly level soils on flood plains. These soils formed mostly in sandy alluvium. They have a water table at a depth of 5 to 8 feet during winter and spring. Permeability is rapid. Slope is 0 to 1 percent. The soils of the Lincoln series are sandy, mixed, thermic Typic Ustifluvents.

Lincoln soils are near Gracemont, Gracemore, Likes, and Yahola soils on the landscape. Gracemont and Gracemore soils have a water table above a depth of 40 inches. Likes soils are on higher convex areas and are not stratified with textures finer than loamy fine sand in the control section. Yahola and Gracemont soils have textures finer than loamy fine sand in the control section.

Typical pedon of Lincoln loamy fine sand in an area of Lincoln loamy fine sand, frequently flooded; 2,300 feet west and 1,950 feet south of the northeast corner of sec. 3, T. 4 N., R. 26 W.

A1—0 to 9 inches; light brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 5/4) moist; single grained; loose, soft; common fine and medium roots; calcareous; moderately alkaline; gradual smooth boundary.

C1—9 to 21 inches; light brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 5/4) moist; single grained; loose, soft; few fine and medium roots; many thin strata of loamy sand and fine sandy loam; calcareous; moderately alkaline; gradual smooth boundary.

C2—21 to 80 inches; pink (7.5YR 7/4) fine sand, light brown (7.5YR 6/4) moist; single grained; loose, soft; few fine and medium roots; many strata of brown (7.5YR 5/4) loamy fine sand and very fine sandy loam that are 1/16 inch to 3 inches thick; calcareous; moderately alkaline.

Typically, the soil is calcareous and moderately alkaline throughout. The average texture of the control section is loamy fine sand or coarser.

The A horizon has hue of 5YR, or 7.5YR, value of 4 to 6, and chroma of 3 or 4.

The C horizon has hue of 5YR to 10YR, value of 6 or 7, and chroma of 3 or 4. Thin strata of loamy materials occur throughout this horizon.

Madge Series

The Madge series consists of deep, well drained, nearly level to very gently sloping soils on uplands. These soils formed in loamy sediment. Permeability is moderate. Slope ranges from 0 to 3 percent. The soils of the Madge series are fine-loamy, mixed, thermic Udic Argiustolls.

Madge soils commonly are on the landscape with Abilene, Carey, Shrewder, and Woodward soils. Abilene soils have more than 35 percent clay in the control section. Carey soils are silt loam or silty clay loam in the control section. Shrewder soils do not have a mollic epipedon and have less than 18 percent clay in the control section. Woodward soils do not have a mollic epipedon and formed in materials weathered from sandstone.

Typical pedon of Madge loam, 1 to 3 percent slopes; 200 feet north and 2,400 feet east of the southwest corner of sec. 19, T. 5 N., R. 25 W.

Ap—0 to 9 inches; reddish brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; moderate fine granular structure; slightly hard, friable; few fine roots; slightly acid; abrupt smooth boundary.

A1—9 to 13 inches; dark reddish gray (5YR 4/2) loam, dark reddish brown (5YR 3/2) moist; moderate fine

subangular blocky structure parting to moderate fine granular; slightly hard, friable; few fine roots; common fine pores; few worm casts; mildly alkaline; gradual smooth boundary.

B1—13 to 18 inches; reddish brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) moist; moderate medium subangular blocky structure parting to moderate medium granular; slightly hard, friable; few fine roots; common fine pores; few worm casts; neutral; gradual smooth boundary.

B21t—18 to 25 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; moderate fine and medium prismatic structure parting to moderate medium subangular blocky; hard, firm; few fine roots; common fine pores; common worm casts; thin continuous clay films on faces of peds; neutral; gradual smooth boundary.

B22t—25 to 41 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate medium prismatic structure parting to weak medium subangular blocky; hard, firm; few fine roots; common fine pores; common worm casts; thin continuous clay films on faces of peds; neutral; gradual smooth boundary.

B3—41 to 57 inches; red (2.5YR 5/6) loam, red (2.5YR 4/6) moist; moderate coarse prismatic structure; hard, friable; few fine roots; patchy clay films on vertical faces of prisms; few pockets of clean sand grains; neutral; gradual smooth boundary.

C—57 to 80 inches; red (2.5YR 5/8) fine sandy loam, red (2.5YR 4/8) moist; massive; slightly hard, friable; moderately alkaline.

The thickness of the solum ranges from 50 to 70 inches. Depth to secondary carbonates is more than 36 inches.

The A1 or Ap horizon has hue of 5YR or 7.5YR, value of 4, and chroma of 2 or 3. It is slightly acid to mildly alkaline.

The B1 horizon has hue of 5YR, value of 4 or 5, and chroma of 3. It is loam or clay loam and is neutral to moderately alkaline. The B21t horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 3 or 4. It is clay loam or loam and is neutral to moderately alkaline. The B22t horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. It is loam, clay loam, or sandy clay loam and is neutral to moderately alkaline. The B3 horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 6 to 8. It is loam or fine sandy loam and is neutral to moderately alkaline. In some pedons the B3 horizon is calcareous. Content of calcium carbonate in the form of concretions and soft bodies ranges from 0 to 5 percent.

The C horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 6 to 8. It is mildly alkaline or moderately alkaline loam, very fine sandy loam, or fine sandy loam. Content of calcium carbonate in this horizon in the form of concretions and soft bodies ranges from 0 to 5 percent. Coarse fragments of soft sandstone or shale, less than 3 inches in diameter, occur in some pedons below a depth of 72 inches.

Mangum Series

The Mangum series consists of deep, well drained, nearly level soils on flood plains. These soils mostly formed in clayey alluvium. Permeability is very slow. Slope is 0 to 1 percent. The soils of the Mangum series are fine, mixed, thermic Vertic Ustochrepts.

Mangum soils commonly are near Beckman, Clairemont, and Spur soils on the landscape. Beckman soils do not have a cambic horizon and are saline. Clairemont soils have less than 35 percent clay in the control section. Spur soils have a mollic epipedon and have less than 35 percent clay in the control section.

Typical pedon of Mangum silty clay loam in an area of Mangum silty clay loam, occasionally flooded; 700 feet east and 150 feet south of the northwest corner of sec. 32, T. 3 N., R. 24 W.

A1—0 to 7 inches; red (2.5YR 4/6) silty clay loam, dark red (2.5YR 3/6) moist; moderate fine and medium blocky structure; hard, firm; few fine roots; few fine calcium carbonate concretions; calcareous; moderately alkaline, gradual smooth boundary.

B—7 to 21 inches; red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; moderate fine and medium blocky structure; extremely hard, very firm; few fine roots; pressure faces along vertical cracks; common fine calcium carbonate concretions; calcareous; moderately alkaline; clear smooth boundary.

C—21 to 65 inches; red (2.5YR 5/6) clay, red (2.5YR 4/6) moist; massive; extremely hard, very firm; few fine roots in upper part; common distinct bedding planes and thin strata of loam and fine sandy loam; common fine gypsum crystals; calcareous; moderately alkaline.

Typically, the soils are moderately alkaline and calcareous throughout. Electrical conductivity of the saturation extract increases as the depth increases. It ranges from 0 to 2 millimhos per centimeter in the A and B2 horizons and from 0 to 4 millimohos per centimeter below a depth of 40 inches. Vertical cracks and pressure faces form in the soils but do not intersect.

The A horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 2 to 6. It is silty clay loam or silty clay 5 to 14 inches thick.

The B horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. It is clay, silty clay, silty clay loam, or clay loam and ranges from 40 to 60 percent clay.

The C horizon is similar to the B horizon in color, texture, and reaction. It has common, faint to distinct

bedding planes or strata 1/16 inch to 2 inches thick. Gypsum crystals and salt crystal range from none to many in this horizon.

McKnight Series

The McKnight series consists of moderately deep to deep, well drained, nearly level to gently sloping soils on convex ridgetops and side slopes on uplands. These soils formed in loamy and sandy sediment of Pleistocene age overlying silty and clayey red beds of Permian Age. Permeability is slow. Slope dominantly ranges from 0 to 5 percent. The soils of the McKnight series are fine-loamy, mixed, thermic Typic Haplustalfs.

McKnight soils commonly are on the landscape with Devol, Grandfield, and Grandmore soils. Devol and Grandfield soils are more than 60 inches over bedrock. In addition, Devol soils are coarse-loamy in the control section. Grandmore soils are underlain by a dark, buried soil at a depth of 30 to 50 inches.

Typical pedon of McKnight loamy fine sand, 0 to 3 percent slopes, in a field; 1,800 feet south and 1,350 feet west of the northeast corner of sec. 3, T. 3 N., R. 26 W.

Ap—0 to 8 inches; yellowish red (5YR 5/6) loamy fine sand, dark reddish brown (5YR 3/4) moist; single grained; loose; few fine roots; neutral; abrupt smooth boundary.

B21t—8 to 23 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; hard, firm; few fine roots; clay bridges between sand grains; thin patchy clay films on faces of peds; mildly alkaline; gradual smooth boundary.

B22t—23 to 33 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak medium prismatic structure parting to weak fine and medium subangular blocky; hard, friable; few fine roots; clay bridges between sand grains; moderately alkaline; abrupt smooth boundary.

IIB3—33 to 45 inches; red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; weak coarse prismatic structure; extremely hard, very firm; few white soft bodies of calcium carbonate; films of calcium carbonate on faces of prisms; calcareous; moderately alkaline; clear smooth boundary.

IICr—45 to 60 inches; red (2.5YR 4/6) clayey shale, dark red (2.5YR 3/6) moist; massive; extremely hard, very firm; interbedded with strata of greenish-gray shale; moderately alkaline.

The thickness of the solum and the depth to bedrock range from 30 to 50 inches. Depth to contrasting material is 20 to 40 inches. The A and B2t horizons range from neutral to moderately alkaline. The IIB3 horizon and the IICR layer are moderately alkaline and calcareous. The average clay content of the upper 20 inches of the Bt horizon is 23 to 35 percent. The absolute difference in clay content between the B2t horizon and the IIB3 horizon is less than 25 percent.

The A horizon has hue of 5YR, value of 4 or 5, and chroma of 3 to 6. It is loamy fine sand or fine sandy loam.

A thin B1 horizon with color and reaction similar to those of the A horizon is in some pedons.

The B2t horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 3 to 6. It is fine sandy loam or sandy clay loam. The IIB3 horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 6. It is silty clay loam, clay loam, or clay and has calcium carbonate ranging from 5 to 30 percent.

The IICR layer has hue of 2.5YR, value of 4 or 5, and chroma of 2 to 6. It consists of soft, rippable sandstone or clayey shale. Olive gray mottles and strata are common in this layer.

Nobscot Series

The Nobscot series consists of deep, well drained, nearly level to strongly sloping soils on sandy uplands. These soils formed in deep sandy deposits of Pleistocene age. Permeability is moderately rapid. Slope is dominantly 2 to 5 percent but ranges to 12 percent. The soils of the Nobscot series are loamy, mixed, thermic Arenic Paleustalfs (fig. 19).

Nobscot soils commonly are on the landscape with Devol and Grandfield soils. Devol and Grandfield soils have a surface layer less than 20 inches thick.

Typical pedon of Nobscot fine sand, 2 to 5 percent slopes; 1,800 feet east and 200 feet south of the northwest corner of sec. 35, T. 4 N., R. 25 W.

A1—0 to 9 inches; brown (7.5YR 5/2) fine sand, dark brown (7.5YR 4/2) moist; single grained; loose; common fine and medium roots; medium acid; clear smooth boundary.

A2—9 to 27 inches; light brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) moist; single grained; loose; few fine and medium roots; slightly acid; clear smooth boundary.

B21t—27 to 40 inches; reddish yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable; a few lamellae about 1/4 to 1/2 inch thick and 3 to 8 inches apart of yellowish red (5YR 5/6) sandy loam; few fine roots; sand grains coated and bridged with clay; slightly acid; gradual smooth boundary.

B22t—40 to 50 inches; reddish yellow (5YR 6/6) loamy fine sand, yellowish red (5YR 5/6) moist; weak coarse prismatic structure; hard, friable; thin lamellae 1/8 to 1/4 inch thick and 3 to 8 inches apart of reddish brown (5YR 5/4) fine sandy loam;

Figure 19.—Profile of Nobscot fine sand, 2 to 5 percent slopes. The scale is in feet.

few fine roots; sand grains coated and bridged with clay; slightly acid; gradual smooth boundary.

B3—50 to 72 inches; reddish yellow (5YR 7/6) loamy fine sand, reddish yellow (5YR 6/6) moist; weak coarse prismatic structure; hard, very friable; thin lamellae 1/8 inch thick and 3 inches apart of reddish yellow (5YR 6/6) loamy fine sand; few pockets of clean sand grains; neutral; gradual smooth boundary.

C—72 to 80 inches; reddish yellow (5YR 7/6) fine sand, reddish yellow (5YR 6/6) moist; single grained; loose; neutral.

The thickness of the solum is more than 60 inches. Combined thickness of the A horizons is 20 to 40 inches.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 to 4. It is fine sand and is medium acid to neutral. In cultivated areas, the A1 and A2 horizons have been mixed. Where cultivated, this horizon is as much as 2 units higher in value and 1 unit higher in chroma than in uncultivated areas. In areas where these soils have been deeply plowed, the subsoil has been mixed with the surface layer.

The B2t horizon has hue of 5YR, value of 5 or 6, and chroma of 6 to 8. It dominantly is fine sandy loam, loamy fine sand, or loamy sand but in the upper 10 inches is sandy loam or fine sandy loam. This horizon contains lamellae of sandy loam or sticky fine sandy loam that are 1/8 inch to 6 inches thick and from 2 to 8 inches apart. It is slightly acid to neutral. The B3 horizon has hue of 5YR, value of 5 to 7, and chroma of 6. It is loamy sand or loamy fine sand and contains lamellae of fine sandy loam or loamy fine sand that are 3 to 8 inches apart and 1/8 to 1 inch thick. This horizon is slightly acid to neutral.

The C horizon is similar to the B3 horizon in texture, color, and reaction.

Quanah Series

The Quanah series consists of deep, well drained, very gently sloping or gently sloping soils on uplands. These soils formed in loamy materials of the Permian red beds. Permeability is moderate. Slope ranges from 1 to 5 percent. The soils of the Quanah series are fine-silty, mixed, thermic Typic Calciustolls.

Quanah soils commonly are on the landscape near the Aspermont, Cornick, Talpa, Tillman, Vernon, and Vinson soils. Aspermont soils do not have a mollic epipedon. Cornick soils are shallow over gypsum. Talpa soils are shallow over limestone. Tillman soils have an argillic horizon and have more than 35 percent clay in the control section. Vernon soils do not have a mollic epipedon and have more than 35 percent clay in the control section. Vinson soils are 20 to 40 inches thick over gypsum.

Typical pedon of Quanah silty clay loam in an area of Quanah-Talpa complex, 1 to 5 percent slopes; 1,600 feet west and 100 feet north of the southeast corner of sec. 13, T. 6 N., R. 27 W.

A1—0 to 14 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; hard, friable;

few worm casts; common fine roots; few fine calcium carbonate concretions; calcareous; moderately alkaline; gradual smooth boundary.

B21—14 to 22 inches; brown (7.5YR 5/2) silty clay loam, dark brown (7.5YR 4/2) moist; moderate fine prismatic structure parting to moderate fine subangular blocky; hard, friable; common worm casts; common fine roots; common fine calcium carbonate concretions; calcareous; moderately alkaline; gradual smooth boundary.

B22—22 to 36 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; moderate fine prismatic structure parting to moderate fine subangular blocky; hard, friable; common fine roots; common medium concretions of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

Cca—36 to 80 inches; brown (7.5YR 5/4) silty clay loam, brown (7.5YR 4/4) moist; massive; hard, friable; common medium concretions and soft bodies of calcium carbonate; calcareous; moderately alkaline.

The thickness of the solum above the Cca horizon is 20 to 40 inches. Thickness of the A horizon is 6 to 14 inches. The soil is moderately alkaline and calcareous throughout.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3.

A B1 horizon is present in some pedons. If present, the B1 has colors similar to the A horizon and texture similar to the B2 horizon. The B2 horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. It is clay loam or silty clay loam. In some pedons, a B22ca horizon or B3ca horizon is present and contains 1 to 5 percent calcium carbonate in the form of concretions, films, and soft bodies.

The Cca horizon has hue of 5YR or 7.5YR, value of 5, and chroma of 4 to 6. It is silty clay loam or clay loam. The Cca horizon contains 15 to 25 percent calcium carbonate in the form of concretions, films, and soft bodies.

Quinlan Series

The Quinlan series consists of shallow, well drained soils on uplands. These soils formed in material weathered from calcareous sandstone and siltstone of the Permian age. Permeability is moderate and moderately rapid. Slope is dominantly less than 8 percent but ranges from 1 to 45 percent. The soils of the Quinlan series are loamy, mixed, thermic, shallow Typic Ustochrepts.

Quinlan soils commonly are on the landscape with Carey and Woodward soils. Carey and Woodward soils do not have sandstone within a depth of 20 inches. In addition, Carey soils have an argillic horizon and a mollic epipedon.

Typical pedon of Quinlan loam in an area of Woodward-Quinlan complex, 5 to 12 percent slopes; 1,240 feet west and 3,100 feet south of the northeast corner of sec. 22, T. 5 N., R. 26 W.

A1—0 to 4 inches; reddish brown (5YR 4/4) loam, dark reddish brown (2.5YR 3/4) moist; moderate fine granular structure; slightly hard, friable; many medium and fine roots; calcareous; moderately alkaline; clear smooth boundary.

B2—4 to 12 inches; red (2.5YR 5/6) loam, red (2.5YR 4/6) moist; weak fine subangular blocky structure; slightly hard, friable; common medium and fine roots; few films of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

Cr—12 to 20 inches; red (2.5YR 5/6) weakly cemented sandstone that has round blue-gray specks 1 millimeter to 4 millimeters in diameter; calcareous; moderately alkaline.

The thickness of the solum ranges from 10 to 20 inches. The soil is generally calcareous throughout, but some pedons are noncalcareous and are moderately alkaline in reaction.

The A horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 3 to 6. It is loam or very fine sandy loam and is mildly alkaline or moderately alkaline.

The B2 horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 8. It is loam or very fine sandy loam and is moderately alkaline.

The Cr layer has hue of 2.5YR, value of 4 to 6, and chroma of 4 to 8. It is most commonly weakly cemented calcareous sandstone, but some pedons are underlain with calcareous siltstone.

Shrewder Series

The Shrewder series consists of deep, well drained, very gently sloping to gently sloping soils on uplands. They formed in loamy eolian and alluvial sediments of Pleistocene age. Permeability is moderately rapid. Slope ranges from 1 to 5 percent. The soils of the Shrewder series are coarse-loamy, mixed, thermic Udic Ustochrepts.

Shrewder soils commonly are on the landscape with Abilene, Madge, and Woodward soils. Abilene and Madge soils have a mollic epipedon and have an argillic horizon. Woodward soils have less than 15 percent material coarser than very fine sand in the control section and are underlain with sandstone at a depth of 20 to 40 inches.

Typical pedon of Shrewder fine sandy loam, 1 to 3 percent slopes; 900 feet north and 700 feet east of the southwest corner of sec. 19, T. 5 N., R. 25 W.

Ap—0 to 8 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak medium

granular structure; slightly hard, very friable; few fine roots; neutral; abrupt smooth boundary.

A1—8 to 16 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable; few fine roots; neutral; gradual smooth boundary.

B2—16 to 31 inches; red (2.5YR 4/6) loam, dark red (2.5YR 3/6) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; few fine roots; neutral; gradual smooth boundary.

B3—31 to 49 inches; red (2.5YR 5/6) loam, red (2.5YR 4/6) moist; weak coarse prismatic structure; slightly hard, very friable; few fine roots; neutral; gradual smooth boundary.

C—49 to 77 inches; red (2.5YR 5/6) very fine sandy loam, red (2.5YR 5/6) moist; massive; slightly hard, very friable; few fine roots; few fine soft bodies of calcium carbonate; few threads and films of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

IICr—77 to 80 inches; red (2.5YR 5/6) soft sandstone; common films of calcium carbonate in seams; moderately alkaline.

The thickness of the solum ranges from 40 to 60 inches. Depth to secondary carbonates ranges from 28 to 60 inches. Depth of soft sandstone bedrock is 60 to 80 inches or more.

The A horizon has a hue of 5YR, value of 4 or 5, and chroma of 3 or 4. It is slightly acid to mildly alkaline.

The B2 horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. It is very fine sandy loam, loam, or fine sandy loam and is neutral to moderately alkaline. The B3 horizon has hue of 2.5YR, value of 4 or 5, and chroma of 6 to 8. It is very fine sandy loam, loam, or fine sandy loam and is neutral to moderately alkaline. In some pedons this horizon is calcareous.

The C horizon has color similar to the B3 horizon. It is very fine sandy loam, fine sandy loam, loam, or loamy fine sand. This horizon is moderately alkaline and is calcareous.

The IICr layer is reddish weakly consolidated sandstone. It is moderately alkaline.

Spur Series

The Spur series consists of deep, well drained, nearly level soils on flood plains. These soils formed in calcareous loamy alluvium. Permeability is moderate. Slope is 0 to 1 percent. The soils of the Spur series are fine-loamy, mixed, thermic Fluventic Haplustolls.

Spur soils commonly are on the landscape near Beckman, Clairemont, Mangum, and Yahola soils. Beckman and Mangum soils do not have a mollic epipedon and have more than 35 percent clay in the control section. Clairemont soils do not have a mollic epipedon. Yahola soils do not have a mollic epipedon and have less than 18 percent clay in the control section.

Typical pedon of Spur clay loam from an area of Spur clay loam, occasionally flooded; 100 feet east and 1,300 feet south of the northwest corner of sec. 12, T. 6 N., R. 26 W.

A1—0 to 11 inches; brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; hard, firm; common fine and medium roots; few worm casts; calcareous; moderately alkaline; clear smooth boundary.

B21—11 to 27 inches; dark yellowish brown (10YR 4/4) clay loam, dark yellowish brown (10YR 3/4) moist; moderate fine subangular blocky structure; hard, firm; common fine roots; many films and threads of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B22—27 to 41 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; hard, firm; few fine roots; common films and threads of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

C—41 to 80 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; massive; hard, firm; stratified thin lenses of sandy loam; a few fragments of red and gray shale; common fine gypsum crystals; common fine films and threads of calcium carbonate; calcareous; moderately alkaline.

This soil is typically moderately alkaline and calcareous throughout. The mollic epipedon ranges from 11 to 20 inches thick.

The A horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 or 3.

The B2 horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 3 or 4. It is loam or clay loam.

The C horizon is similar in color and texture to the B2 horizon. It has common thin strata of clay loam, silty clay loam, or fine sandy loam. Gypsum crystals or fragments of shale are present in this horizon. In some pedons, a dark buried layer is between a depth of 30 and 50 inches.

Talpa Series

The Talpa series consists of shallow and very shallow, well drained, very gently sloping or gently sloping soils on uplands. These soils formed in material weathered from limestone of Permian age. Permeability is moderate. Slope ranges from 1 to 5 percent. The soils of the Talpa series are loamy, mixed, thermic Lithic Calciustolls.

Talpa soils commonly are on the landscape with Aspermont, Cornick, Knoco, Quanah, Vernon, and Vinson soils. Aspermont soils do not have a mollic epipedon and have a solum more than 20 inches thick.

Cornick soils are shallow over gypsum. Knoco soils are very shallow over clayey shale. Quanah soils have a solum more than 20 inches thick. Vernon soils have a solum more than 20 inches thick and have more than 35 percent clay in the control section. Vinson soils are 20 to 40 inches deep over gypsum.

Typical pedon of Talpa loam in an area of Quanah-Talpa complex, 1 to 5 percent slopes; 1,500 feet west and 100 feet north of the southeast corner of sec. 13, T. 6 N., R. 27 W.

A1—0 to 11 inches; brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; hard, friable; many fine roots; common fine and medium concretions and few threads of calcium carbonate; about 10 percent by volume coarse fragments of limestone; about 10 percent of surface covered with coarse fragments of limestone; calcareous; moderately alkaline; abrupt smooth boundary.

R—11 to 15 inches; indurated grayish dolomitic limestone that cannot be penetrated with a spade; secondary coatings of calcium carbonate in the cracks and crevices of the limestone.

The thickness of the solum ranges from 5 to 14 inches. The soil is calcareous throughout. The solum contains 10 to 35 percent, by volume, coarse fragments of limestone. The A horizon has hue of 7.5YR, value of 4 or 5, and chroma of 2 or 3. The R layer is hard, grayish dolomitic limestone.

Tillman Series

The Tillman series consists of deep, well drained, nearly level or very gently sloping soils on flat or convex uplands. These soils formed mostly in old clayey alluvium over shale of Permian age. Permeability is slow. Slope ranges from 0 to 3 percent. The soils of the Tillman series are fine, mixed, thermic Typic Paleustolls (fig. 20).

Tillman soils commonly are on the landscape with Aspermont, Hollister, Quanah, and Vernon soils. Aspermont soils are on convex slopes, do not have a mollic epipedon, and have less than 35 percent clay in the control section. Hollister soils have a mollic epipedon more than 20 inches thick. Quanah soils do not have an argillic horizon and have less than 35 percent clay in the control section. Vernon soils are on lower lying convex slopes, do not have a mollic epipedon, and are less than 40 inches deep.

Typical pedon of Tillman clay loam, 1 to 3 percent slopes; 700 feet east and 800 feet south of the northwest corner of sec. 35, T. 3 N., R. 25 W.

Ap—0 to 5 inches; reddish brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) moist; weak medium granular structure; slightly hard, friable; calcareous; moderately alkaline; abrupt smooth boundary.

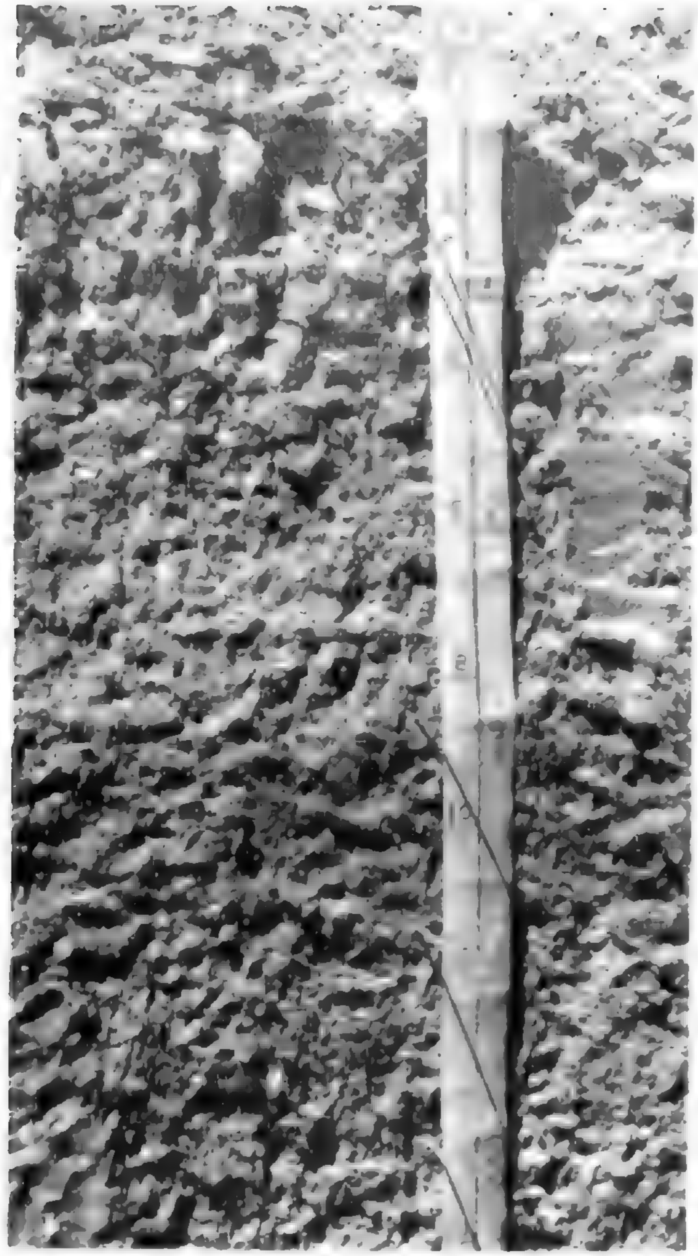


Figure 20.—Profile of Tillman clay loam showing the blocky structure of the subsoil. Multiply the figure on the left side of the scale by 10 to determine the depth in centimeters. The figure on the right is in feet.

A1—5 to 12 inches; dark reddish brown (5YR 3/2) clay loam, dark reddish brown (5YR 2/2) moist; moderate medium granular structure; slightly hard,

friable; calcareous; moderately alkaline; clear smooth boundary.

B21t—12 to 19 inches; dark reddish gray (5YR 4/2) clay, dark reddish brown (5YR 3/2) moist; moderate fine prismatic structure parting to moderate fine blocky; extremely hard, very firm; common clay films on faces of peds; few fine concretions of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B22t—19 to 39 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate fine prismatic structure parting to moderate fine blocky; extremely hard, very firm; common clay films on faces of peds; few medium concretions and common fine soft bodies of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B23t—39 to 51 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; moderate fine prismatic structure parting to moderate fine blocky; extremely hard, very firm; common patchy clay films on faces of peds; few medium concretions and common fine soft bodies of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B3—51 to 62 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; weak medium prismatic structure parting to weak medium subangular blocky; extremely hard, very firm; 10 percent by volume shale fragments; common medium concretions and soft bodies of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C—62 to 80 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; massive; extremely hard, very firm; thin strata of brown (7.5YR 5/2) clay; about 15 percent by volume shale fragments; calcareous; moderately alkaline.

The thickness of the solum is more than 60 inches. The soil is moderately alkaline throughout.

The A horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 2 or 3.

In some pedons, a B1 horizon is present. It is similar in color, texture, and reaction to the A horizon. The B2t horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 3 to 6. It is clay loam or clay. The lower part of the B2t horizon in most pedons has an accumulation of calcium carbonate in the form of soft bodies and concretions. The B3 horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. It is clay or clay loam. The B3 horizon has an accumulation of calcium carbonate in the form of soft bodies and concretions.

The C horizon is red, yellowish red, bluish gray, or olive clay, shaly clay, or weakly consolidated shale.

Tipton Series

The Tipton series consists of deep, well drained, nearly level or very gently sloping soils on stream terraces. These soils formed in loamy alluvium of Pleistocene age. Permeability is moderate. Slope ranges from 0 to 3 percent. The soils of the Tipton series are fine-loamy, mixed, thermic Pachic Argiustolls (fig. 21).

Tipton soils commonly are on the landscape with Acme, Altus, Grandfield, Hardeman, Vinson, and Westview soils. Acme and Vinson soils are over gypsum. Altus soils are fine sandy loam and sandy clay loam in the control section. Grandfield soils do not have a mollic epipedon. Hardeman soils have less than 18 percent clay in the control section and do not have a mollic epipedon. Westview soils have less than 15 percent fine sand or coarser material in the control section.

Typical pedon of Tipton loam, 0 to 1 percent slopes; 2,700 feet west and 250 feet south of the northeast corner of sec. 5, T. 2 N., R. 26 W.

Ap—0 to 9 inches; dark reddish gray (5YR 4/2) loam, dark reddish brown (5YR 3/2) moist; moderate fine granular structure; slightly hard, friable; neutral; clear smooth boundary.

B1—9 to 15 inches; dark reddish brown (5YR 3/2) loam, dark reddish brown (5YR 2/2) moist; moderate fine and very fine subangular blocky structure; slightly hard, friable; few fine roots; common worm casts; mildly alkaline; gradual smooth boundary.

B21t—15 to 22 inches; dark reddish gray (5YR 4/2) clay loam, dark reddish brown (5YR 3/2) moist; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; hard, firm; few fine roots; continuous clay films on faces of peds; common worm casts; mildly alkaline; gradual smooth boundary.

B22t—22 to 38 inches; reddish brown (5YR 5/3) clay loam, reddish brown (5YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; few fine roots; continuous clay films on faces of peds; common worm casts; moderately alkaline; gradual smooth boundary.

B3—38 to 52 inches; reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; weak medium prismatic structure; hard, friable; few fine roots; common worm casts; few films of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C—52 to 80 inches; yellowish red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; massive; slightly hard, friable; calcareous; moderately alkaline.

The thickness of the solum ranges from 50 to 80 inches or more. In areas that are irrigated, the soil has common threads of gypsum.

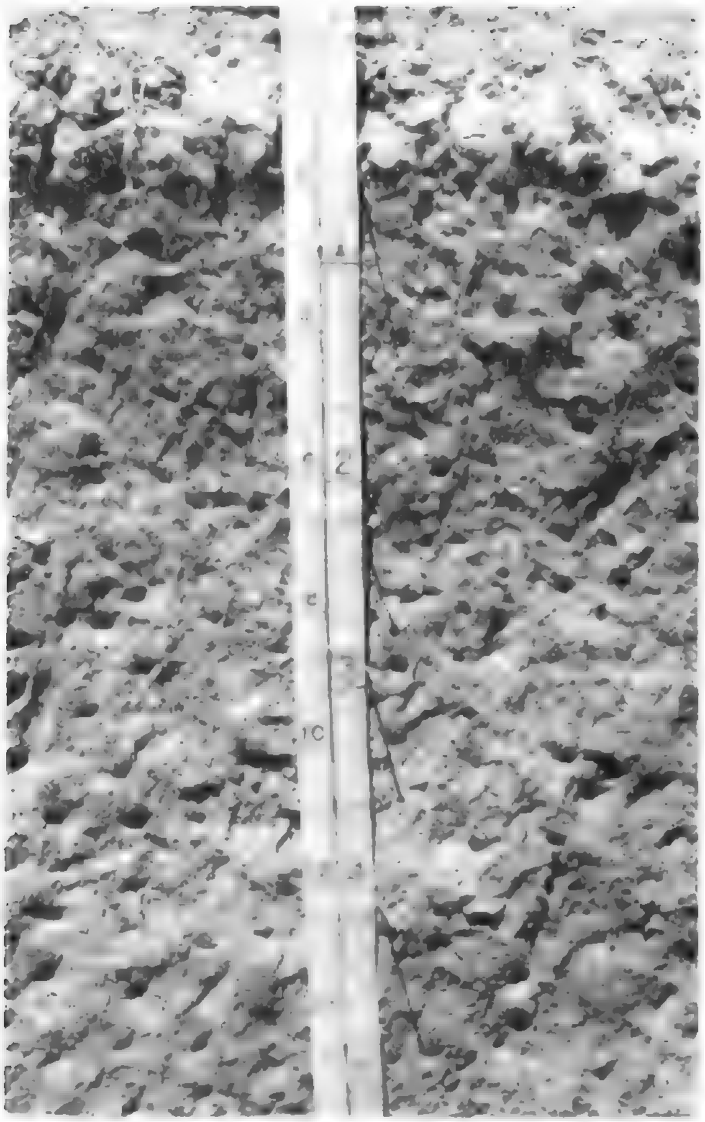


Figure 21.—Profile of Tipton loam, 0 to 1 percent slopes. Multiply the figure on the left side of the scale by 10 to determine the depth in centimeters. The figure on the right is in feet.

The A horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 or 3. It is neutral or mildly alkaline.

The B1 horizon has hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 2 or 3. It is neutral or mildly alkaline. The B2t horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. It is mildly alkaline or moderately alkaline loam or clay loam. The B3 horizon has hue of 5YR, value of 5 or 6, and chroma of 4 to 6. It is loam or clay loam. The B3 horizon is mildly alkaline or moderately alkaline and is calcareous in some pedons.

The C horizon has color and texture similar to those of the B3 horizon. It is moderately alkaline and is calcareous in some pedons.

The Tipton soils in map unit 58 are taxadjuncts to the Tipton series because they have a slightly thinner mollic epipedon than is typical for the Tipton series. Behavior, use, and management are similar to those of the Tipton series.

Tivoli Series

The Tivoli series consists of deep, excessively drained, sloping to moderately steep soils mainly on high dunes adjacent to flood plains. These soils formed in sandy eolian sediment. Permeability is rapid. Slope is dominantly less than 12 percent but ranges from 8 to 20 percent. The soils of the Tivoli series are mixed, thermic Typic Ustipsamments.

Tivoli soils are associated on the landscape with Devol, Hardeman, and Likes soils. Devol soils are on higher lying convex slopes than Tivoli soils, are less sandy, and have an argillic horizon. Hardeman soils are on lower lying convex side slopes, are less sandy, and have a cambic horizon. Likes soils are on lower parts of the flood plain and are calcareous throughout.

Typical pedon of Tivoli fine sand; 500 feet north and 500 feet west of the southeast corner of sec. 32, T. 5 N., R. 26 W.

A1—0 to 13 inches; brown (7.5YR 5/4) fine sand, dark brown (7.5YR 4/4) moist; single grained; soft, very friable; common medium and fine roots; mildly alkaline; clear smooth boundary.

C1—13 to 30 inches; reddish yellow (5YR 6/6) fine sand, yellowish red (5YR 5/6) moist; single grained; loose, soft; few medium and fine roots; moderately alkaline; clear smooth boundary.

C2—30 to 80 inches; reddish yellow (5YR 6/6) fine sand, yellowish red (5YR 5/6) moist; single grained; loose; few fine roots; calcareous; moderately alkaline.

The depth to calcareous material ranges from 13 to 40 inches or more.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. It is slightly acid to mildly alkaline.

The C horizon has hue of 5YR or 7.5YR, value of 6 or 7, and chroma of 4 to 6. It is fine sand or sand. This horizon is neutral to moderately alkaline in the upper part. It is moderately alkaline and calcareous in the lower part. A buried soil is present in some pedons.

The Tivoli soils in Harmon County are taxadjuncts to the Tivoli series because they are calcareous in the upper part of the C horizon. Behavior, use, and management are similar to those of the Tivoli series.

Vernon Series

The Vernon series consists of moderately deep, well drained, very gently sloping to strongly sloping soils on uplands. These soils formed in Permian age clays and shales. Permeability is very slow. Slope ranges from 1 to 12 percent. The soils of the Vernon series are fine, mixed, thermic Typic Ustochrepts (fig. 22).

Vernon soils commonly are adjacent on the landscape to Aspermont, Cornick, Hollister, Knoco, Quanah, Talpa, and Tillman soils. Aspermont and Quanah soils have less than 35 percent clay in the control section. In addition, Quanah soils have a mollic epipedon and a calcic horizon. Cornick soils are less than 10 inches deep over gypsum. Knoco soils are less than 12 inches deep over shale. Talpa soils are less than 14 inches deep over limestone. Tillman and Hollister soils are more than 40 inches deep and have an argillic horizon and a mollic epipedon.

Typical pedon of Vernon clay loam, 1 to 3 percent slopes; 3,500 feet south and 1,200 feet west of the northeast corner of sec. 4, T. 2 N., R. 25 W.

Ap—0 to 7 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; hard, firm; few fine roots; calcareous; moderately alkaline; abrupt smooth boundary.

B2—7 to 20 inches; reddish brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; moderate fine subangular blocky structure; very hard, very firm; few fine roots; many fine and medium concretions of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B3—20 to 34 inches; red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; moderate fine subangular structure; very hard, extremely firm; few fine roots; few pockets of gypsum crystals; 10 percent by volume coarse fragments of red and blue gray shale less than 76 millimeters in diameter; common films and common fine and medium concretions of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

Cr—34 to 60 inches; red (2.5YR 4/6) weakly consolidated shale, dark red (2.5YR 3/6) moist; thin strata of blue gray shale; few soft bodies of gypsum crystals; common medium soft bodies of calcium carbonate; calcareous; moderately alkaline.

The thickness of the solum and the depth to red beds range from 20 to 40 inches. Typically, the soil is calcareous and moderately alkaline throughout, but some pedons are noncalcareous in the upper few inches.

The A horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 2 to 6.

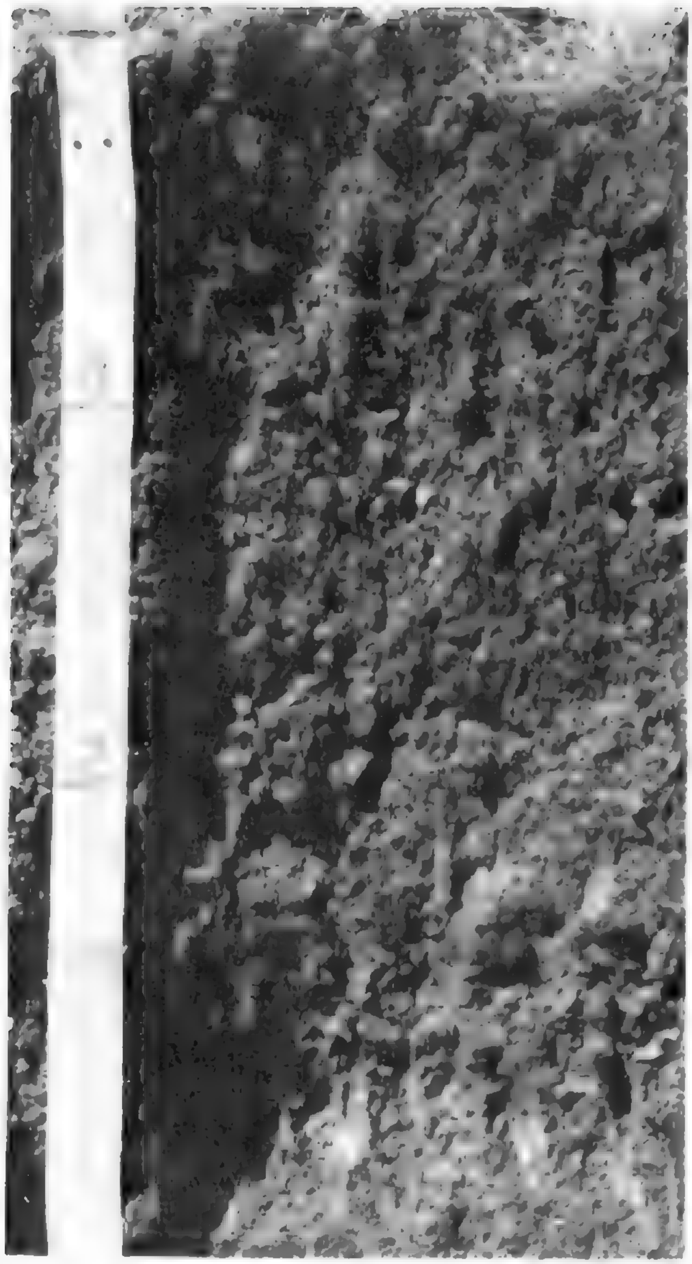


Figure 22.—Profile of Vernon clay loam. The dense clayey subsoil has blocky structure. Weathered shale and clay are at a depth of about 34 inches. The scale is in feet.

The B2 horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 3 to 6. It is clay or silty clay. The B3 horizon has hue of 2.5YR, value of 4 or 5, and chroma of 4 to 6. It is clay or silty clay and has 0 to 10 percent, by volume, coarse fragments of shale less than 76 millimeters in diameter.

The Cr layer has hue of 2.5YR, value of 4 or 5, and chroma of 4 to 6. It is weakly consolidated, calcareous shale or clay.

Vinson Series

The Vinson series consists of moderately deep, well drained, very gently sloping or gently sloping, loamy soils on uplands. These soils formed in materials weathered from gypsum of Permian age. Permeability is moderate. Slope ranges from 1 to 5 percent. The soils of the Vinson series are fine-silty, mixed, thermic Entic Haplustolls.

Vinson soils commonly are on the landscape with Abilene, Acme, Aspermont, Cornick, Knoco, Quanah, Talpa, Tipton, and Westview soils. Abilene, Tipton, and Westview soils are more than 60 inches deep. Acme and Cornick soils are less than 20 inches deep over gypsum. Aspermont soils do not have a mollic epipedon and are not underlain by gypsum. Knoco soils are 3 to 12 inches thick over Permian red bed shales or clays. Quanah soils have a calcic horizon. Talpa soils are less than 14 inches deep over limestone.

Typical pedon of Vinson silt loam in an area of Cornick-Vinson-Rock outcrop complex, 1 to 5 percent slopes; 4,200 feet east and 300 feet north of the southwest corner of sec. 8, T. 6 N., R. 26 W.

A1—0 to 18 inches; brown (7.5YR 4/2) silt loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; hard, friable; many fine roots; few fine soft bodies of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B2—18 to 25 inches; brown (7.5YR 5/2) silty clay loam, brown (5YR 4/2) moist; weak medium subangular blocky structure; hard, friable; common fine roots; few fine concretions of calcium carbonate; calcareous; moderately alkaline; abrupt smooth boundary.

Cr—25 to 30 inches; white gypsite, the upper few inches are calcareous and the fractures contain coatings of secondary calcium carbonate; mass is noncalcareous; massive; can be dug with difficulty with a spade.

The depth to gypsum bedrock ranges from 20 to 40 inches. Clay content in the control section ranges from 18 to 30 percent.

The A horizon has hue of 5YR or 7.5YR, value of 4, and chroma of 2 or 3. It is moderately alkaline and is calcareous.

The B2 horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. It is silt loam or silty clay loam.

The Cr horizon is white gypsite. In some pedons it contains hard alabaster below a depth of 4 feet, but depth to this layer is quite variable within short distances. Fractures in the upper few inches of the Cr horizon contain coatings of secondary calcium carbonate.

The Vinson soils in complex with Acme soils are underlain by soft crystalline gypsiferous material, which contrasts with the more compact gypsite underlying the Vinson soils in complex with Cornick soils.

Westview Series

The Westview series consists of deep, well drained, nearly level soils on stream terraces. These soils formed in silty alluvial sediment of Pleistocene age. Permeability is slow. Slope is 0 to 1 percent. The soils of the Westview series are fine-silty, mixed, thermic Pachic Argiustolls.

Westview soils are similar to Tipton soils and commonly are on the landscape with Acme, Altus, Tipton, and Vinson soils. Acme and Vinson soils are less than 40 inches deep over gypsum. Altus and Tipton soils have more than 15 percent fine sand or coarser material in the control section.

Typical pedon of Westview silty clay loam, 0 to 1 percent slopes; 1,820 feet south and 2,260 feet west of the northeast corner of sec. 5, T. 2 N., R. 26 W.

Ap—0 to 6 inches; reddish brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) moist; moderate fine blocky structure; hard, firm; few fine roots; neutral; abrupt smooth boundary.

B21t—6 to 15 inches; reddish brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; few fine roots; thin patchy clay films on faces of peds; mildly alkaline; clear smooth boundary.

B22t—15 to 22 inches; reddish brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) moist; moderate medium prismatic structure parting to moderate subangular blocky; hard, firm; few fine roots; thin nearly continuous clay films on faces of peds; moderately alkaline; clear smooth boundary.

B23t—22 to 36 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, firm; few fine roots; thin patchy clay films on faces of peds; few fine concretions and few threads of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B3—36 to 50 inches; light reddish brown (5YR 6/4) silty clay loam, reddish brown (5YR 5/4) moist; weak medium subangular blocky structure; hard, firm; few fine roots; calcareous; moderately alkaline; gradual smooth boundary.

C—50 to 80 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; massive; hard, firm; calcareous; moderately alkaline.

The thickness of the solum ranges from 50 to 70 inches. Depth to soft powdery secondary lime is 19 to 30 inches. The mollic epipedon is 20 to 45 inches thick.

The Ap or A1 horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. It ranges from neutral to moderately alkaline.

A B1 horizon is present in some pedons. It is 4 to 6 inches thick and has color, texture, and reaction similar to those of the A1 horizon. The B21t horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. It is silty clay loam or clay loam and is mildly alkaline or moderately alkaline. The B22t horizon or B23t horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. It is silty clay loam or clay loam. The B3 horizon has hue of 5YR, value of 4 to 6, and chroma of 4 to 6. It is silt loam, silty clay loam, clay loam, or loam.

The C horizon has color, texture, and reaction similar to those of the B3 horizon.

Woodward Series

The Woodward series consists of moderately deep, well drained, very gently sloping to strongly sloping soils on uplands. These soils formed in the residuum of soft sandstone of Permian age. Permeability is moderate. Slope ranges from 1 to 12 percent. The soils of the Woodward series are coarse-silty, mixed thermic Typic Ustochrepts.

Woodward soils are on the landscape near Carey, Hardeman, Quinlan, Shrewder, and Madge soils. Carey and Madge soils are deeper, have more than 18 percent clay in the control section, and have a mollic epipedon. Hardeman and Shrewder soils do not have sandstone bedrock within a depth of 72 inches and have more than 15 percent material coarser than very fine sand in the control section. Quinlan soils have bedrock within a depth of 20 inches.

Typical pedon of Woodward loam, 1 to 3 percent slopes; 300 feet north and 2,500 feet east of the southwest corner of sec. 15, T. 5 N., R. 26 W.

Ap—0 to 8 inches; yellowish red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; weak fine granular structure; hard, friable; few fine roots; moderately alkaline; abrupt smooth boundary.

A1—8 to 15 inches; reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure parting to moderate medium granular; hard, very friable; few fine roots; calcareous; moderately alkaline; clear smooth boundary.

B2—15 to 32 inches; red (2.5YR 4/6) loam, dark red (2.5YR 3/6) moist; weak medium and coarse prismatic structure; hard, friable; few fine roots; few films of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B3—32 to 38 inches; red (2.5YR 5/6) very fine sandy loam, red (2.5YR 4/6) moist; weak coarse prismatic structure; hard, friable; 10 percent by volume soft sandstone fragments; few films of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

Cr—38 to 60 inches; red (2.5YR 4/6) soft weakly cemented sandstone; calcareous; moderately alkaline.

The thickness of the solum ranges from 20 to 40 inches. Depth to secondary calcium carbonates ranges from 10 to 36 inches.

The A horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 3 to 6. It is neutral to moderately alkaline.

The B2 horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 6. It is loam or very fine sandy loam and is mildly alkaline or moderately alkaline. In some pedons, the B2 horizon has a few soft bodies and a few hard concretions of calcium carbonate. The B3 horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 8. It is loam or very fine sandy loam, is mildly alkaline or moderately alkaline, and is calcareous. In some pedons, the B3 horizon has few to many soft bodies and hard concretions of calcium carbonate.

The Cr layer has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 6 to 8. It mainly is soft, weakly cemented, calcareous sandstone but is noncalcareous in some pedons.

Yahola Series

The Yahola series consists of deep, well drained, nearly level soils on flood plains. These soils formed in loamy alluvium. Permeability is moderately rapid. Slope is 0 to 1 percent. The soils of the Yahola series are coarse-loamy, mixed, (calcareous), thermic Typic Ustifluvents.

Yahola soils commonly are on the landscape near Clairemont, Gracemont, Gracemore, Likes, Lincoln, and Spur soils. Clairemont soils have more than 18 percent clay and have less than 15 percent coarser than very fine sand in the control section. Gracemont and Gracemore soils have a water table above a depth of 40 inches at a time during the year. Likes soils are on the higher part of the flood plains and are loamy fine sand or coarser throughout. Lincoln soils have a sandy control section. Spur soils have a mollic epipedon and have more than 18 percent clay in the control section.

Typical pedon of Yahola fine sandy loam in an area of Yahola fine sandy loam, occasionally flooded; 3,900 feet south and 300 feet west of the northeast corner of sec. 30, T. 5 N., R. 26 W.

Ap—0 to 5 inches; reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; hard, very friable; common

fine roots; few worm casts; calcareous; moderately alkaline; abrupt smooth boundary.

C1—5 to 21 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; massive; slightly hard, very friable; few worm casts; common fine roots; few thin strata of silt loam and loam; calcareous; moderately alkaline; clear smooth boundary.

C2—21 to 80 inches; reddish brown (5YR 5/4) fine sandy loam; reddish brown (5YR 4/4) moist; massive; slightly hard, very friable; few fine roots; common strata 1/8 to 1 inch thick of silt loam, loam, and loamy fine sand; calcareous; moderately alkaline.

Typically, the soil is moderately alkaline and calcareous throughout.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4.

The C horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 3 to 6. It is fine sandy loam or loam. The C horizon has common, thin strata of silt loam, loam, and loamy fine sand. In some areas, buried soils are present below a depth of 40 inches.

Formation of the Soils

The general geology of the survey area is described in this section. Also described are the major factors of soil formation and the processes of soil formation as they relate to the soils in Harmon County.

Geology

Kenneth S. Johnson, Oklahoma Geological Survey, prepared this section.

Outcropping rock units in Harmon County are sedimentary. They consist of strata and sediments of Permian and Quaternary ages (*3, 4*). The Permian strata are mainly red-bed shales and sandstones that are interbedded with resistant layers of gypsum and dolomite. The Quaternary sediments consist chiefly of unconsolidated sands, silts, clay, and gravels deposited as alluvium along the present rivers and streams, or deposited by ancient river systems that once coursed through the area. For information on the geological formations in Harmon County, see the generalized geology map at the back of this publication.

Based upon the presence of marine fossils (clam shells) in some formations of dolomites that crop out in the county and on the presence of gypsum and salt deposits in these strata, geologists believe that most of these Permian rocks were deposited in a shallow sea. This sea occupied most of the western part of Oklahoma during the middle part of the Permian Period, about 250 million years ago. Westward-flowing streams drained ancient land areas in the eastern parts of Oklahoma and Texas and carried mud, silt, and sand into this shallow sea. Currents and tides spread the fine, red sediment across the sea floor, and the sediment formed layers of red-brown shale and sandstone.

Periodically, the concentration of dissolved solids in the sea water was high enough so that "evaporite" rocks, dolomite, gypsum, and rock salt, were precipitated on the sea floor. Dolomite beds in the county are typically 0.5 to 6.0 feet thick, are light gray or tan, and, depending on their hardness and resistance to erosion, function as caprock on benches or mesas. Gypsum is typically white to light gray and is in layers or beds 1 to 30 feet thick. It is a moderately soluble rock, but in this semiarid region it generally resists erosion and functions as caprock on many bluffs and benches. Layers of rock salt were deposited in the northern half of the county. This type of rock is highly soluble. The layers mainly are at a depth ranging from 30 to 400 feet.

Permian strata that crop out in Harmon County include (in ascending order) the Flowerpot Shale, Blaine Formation, Dog Creek Shale, and Whitehorse Group (fig. 23). Each of these formations is about 100 to 300 feet thick and consists of a distinctive major rock type that distinguishes it from underlying and overlying formations.

The Flowerpot Shale, the oldest rock formation that crops out in Harmon County, consists mainly of red-brown shale with several interbeds of green-gray shale and gypsum that are individually 0.5 foot to 3.0 feet thick. Total thickness of the formation is about 300 feet. Outcrops are restricted to the far northern part of the county in the cliffs and bluff faces along the Elm Fork of the Red River. The Flowerpot Shale dips southward from these outcrops and underlies all parts of the county. Interbedded with the red-brown shale are moderately thick layers of rock salt, or "Flowerpot" salt. This salt is restricted to the subsurface in the northern part of the county, and where the salt is at a shallow depth adjacent to the Elm Fork of the Red River it is being dissolved by ground water. The resultant saltwater brine is being emitted from springs in three canyons west of State Highway 30. The Knoco and Vernon soils are associated with this formation.

Directly overlying the Flowerpot Shale is the Blaine Formation, which consists of 9 principal gypsum beds, each 5 to 30 feet thick, that are separated by red shale beds (each 0.5 foot to 20 feet thick) and gray dolomite beds (each 0.5 foot to 6.0 feet thick). The Blaine Formation is about 200 feet thick in Harmon County. The formation crops out only in small areas in the northern, northeastern, and southeastern parts of the county and in a fairly large area south of Hollis. The Blaine Formation underlies almost all other parts of the county. It is especially important as the major source of fresh, gyppy ground water in the southern part of the county. The Vernon, Knoco, Quanah, Talpa, Vinson, Cornick, and Aspermont soils are associated with this formation.

The Dog Creek Shale is the most widespread formation in outcrops in Harmon County. The formation consists chiefly of red-brown shale, but it also contains several white gypsum beds (each 3 to 10 feet thick) and several gray dolomite beds (each 0.5 foot to 2.0 feet thick) in the bottom 50 feet of the formation. The total thickness of the Dog Creek Shale ranges from about 100

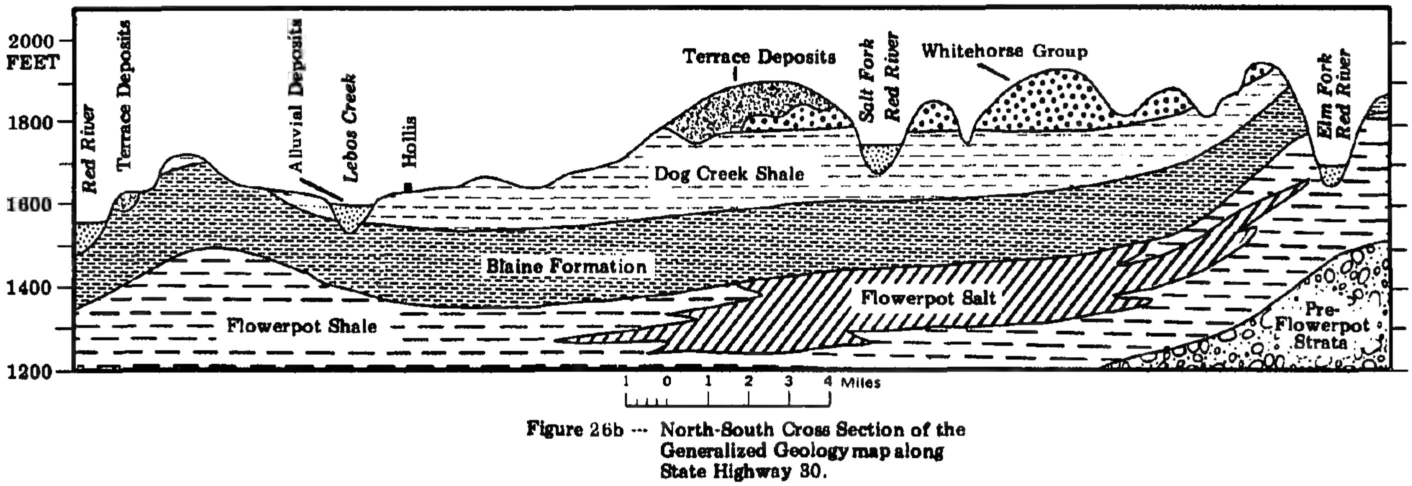


Figure 23.—General geology map of Harmon County. North-south cross section along State Highway 30.

feet in the northern part of the county to nearly 200 feet in the central part. The Vernon, Tillman, Hollister, Knoco, and Aspermont soils are associated with this formation. Extensive areas of Badland are also throughout the Dog Creek Shale.

The Whitehorse Group, the youngest Permian rock unit in the county, consists mainly of orange-brown to red-brown sand and sandstone, but also contains several white, chaotically distributed gypsum beds, each about 2 to 5 feet thick. Principal outcrops of the Whitehorse Group are north of the Salt Fork of the Red River, but several outcrops are in the central part of the county. The top of the Whitehorse Group is eroded in all parts of the county, and the remaining thickness of the unit ranges from about 20 to 100 feet in various areas. The Woodward, Carey, and Quinlan soils are associated with this unit.

Quaternary deposits in the county are generally 10 to 100 feet thick and consist mainly of sand, gravel, and clay eroded from nearby Permian rocks and from other rock formations farther west in the Texas Panhandle. Most of the Quaternary material was laid down as flood plain or alluvial deposits along major rivers and streams flowing to the east and southeast across the county. The deposits commonly are buff, tan, brown, and pale reddish brown, and they are rarely cemented. Locally these deposits contain the bones of large vertebrates (elephants, horses, and camels), the bones of small vertebrates, petrified wood, and the shells of small snails and clams.

When a river shifts its position or cuts deeply into underlying rocks, the original flood plain or alluvial deposits are left behind as terraces marking the earlier location and elevation of the stream. Quaternary terrace deposits occur chiefly along and south of the Salt Fork of the Red River, but similar deposits also are present near the Red River.

The Altus, Devol, Grandfield, Grandmore, Hardeman, McKnight, Tipton, and Tivoli soils are associated with Quaternary terrace deposits. Quaternary alluvial deposits are those that are now forming, or have been recently formed, along the course of present streams and rivers in the county. The Yahola, Lincoln, Gracemont, Gracemore, Clairemont, Spur, Mangum, Tipton, and Westview soils are associated with alluvial deposits.

In many parts of Harmon County a veneer of terrace deposits, 2 to 10 feet thick, overlie the Permian bedrock. Most of the smaller streams also are bordered by flat-surfaced alluvial deposits 5 to 10 feet thick. The Abilene, Shrewder, and Madge soils are associated with thin, old terrace deposits scattered across the county.

Factors of Soil Formation

Soil is the product of five major factors of soil formation—parent material, climate, plants and animals (especially plants), relief, and time. If a given factor, vegetation for example, differs from one area to another, but the other four factors remain the same, the soil formed in the two areas differs.

Parent Material

Soils form in unconsolidated material that influences the rate of formation, the chemical, physical, and mineral composition of the soil, and the color of the soil.

Soils on the uplands of Harmon County formed in material weathered from sandstone, clay, shale, gypsum, and limestone. Quinlan and Woodward soils are examples of soils that formed in materials weathered

from sandstone. Knoco, Tillman, and Vernon soils formed in materials weathered from Permian clay and shale. Vinson and Cornick soils formed in material weathered from gypsum, and Talpa soils formed in material weathered from limestone.

Alluvial sediment is extensive along the streams and rivers of the county. The kind of sediment deposited and the kinds of soil that formed in it depend largely on the source of the sediment and the velocity of the floodwater. Clairemont and Spur soils formed in loamy sediment deposited near streams when these streams overflowed. Beckman and Mangum soils formed in clayey sediment deposited by narrow streams carrying large amounts of clay-size particles. Lincoln and Yahola soils formed in sandy sediment deposited by fast moving water near the stream.

Climate

Harmon County has a dry subhumid climate. The climate is fairly uniform throughout the county; differences among soils cannot be attributed to differences in climate. Moisture and warm temperature have been sufficient to promote the formation of distinct layers in many of the soils. Soil leaching is slow because of limited precipitation.

Plants and Animals

Plants, burrowing animals, insects, and soil micro-organisms have a direct influence on the formation of soils. The native grasses and trees in the county have had different effects on the losses and gains of organic matter and plant nutrients and on the soil structure and porosity. Soils that formed under prairie vegetation, such as those of the Carey and Tipton series, have a dark grayish brown surface layer and a moderately high content of organic matter. Soils that formed under trees, such as those of the Nobscot series, have a brown surface layer and a low content of organic matter.

Relief

Relief influences the formation of the soils mainly through its effect on movement of water, erosion, soil temperature, and the kind of plant cover. In Harmon County, relief is determined largely by the resistance of underlying formations to weathering and geological erosion. About 6 percent of the acreage is nearly level soils on flood plains, and about 94 percent is nearly level to steep soils on uplands.

Carey and Quinlan soils formed in similar sandstone parent material. Their development, however, was controlled to a large extent by relief, and the deep Carey soils are less sloping than the shallow Quinlan soils.

Time

As a factor in soil formation, time is difficult to measure strictly in years. The length of time needed for development of genetic horizons depends on the intensity and the interactions of soil-forming factors in promoting the losses, gains, transfers, or transformations of the constituents necessary in forming soil horizons. Soils that have no definite genetic horizons are young or immature. Mature or older soils have approached equilibrium with their environment and tend to have well defined horizons.

The soils in Harmon County range from young to old. Hollister and Tillman soils are examples of old soils on uplands. Carey and Tipton soils are younger, but they have well expressed horizons. The Quinlan and Woodward soils are considered young soils. They have had sufficient time to develop well expressed horizons; but, because they are sloping, geological erosion has taken away soil material almost as fast as it formed. Lincoln and Yahola soils are young soils that formed in recent sediments on flood plains and show little horizon development.

Processes of Soil Formation

Several processes were involved in the formation of the soils in Harmon County. These processes are the accumulation of organic matter, the leaching of calcium carbonates and bases, the reduction and transfer of iron, and the formation and translocation of silicate clay minerals. The results of these processes are not evident to the same degree in all the soils of the county.

Most of the older soils in the county have three major horizons. Some of the properties in which the major horizons differ are color, texture, structure, consistency, reaction, content of organic matter, and thickness. Subdivisions of the major horizons are based on minor differences.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Broad-base terrace. A ridge-type terrace built to control erosion by diverting runoff along the contour at a nonscouring velocity. The terrace is 10 to 20 inches high and 15 to 30 feet wide and has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. It may be nearly level or have a grade toward one or both ends.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for

significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess alkali (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual.* The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Arabic numeral 2 precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow.. less than 0.06 inch

Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plinthite. The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents. It commonly appears as red mottles, usually in platy, polygonal, or reticulate patterns. Plinthite changes irreversibly to an ironstone hardpan or to irregular aggregates on repeated wetting and drying, especially if it is exposed also to heat from the sun. In a moist soil, plinthite can be cut with a spade. It is a form of laterite.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slyghtly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Salty water (in tables.) Water that is too salty for consumption by livestock.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Saprolite (soil science). Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium absorption ratio (SAR) of a saturation extract, or the ratio of Na! to Ca!! + Mg!!. The degrees of sodicity are—

	SAR
Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Too arid (in tables). The soil is dry most of the time, and vegetation is difficult to establish.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Toxicity (in tables). Excessive amount of toxic substances, such as sodium or sulfur, that severely hinder establishment of vegetation or severely restrict plant growth.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-74 at Hollis, Oklahoma]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	53.4	24.4	38.9	80	1	24	.50	.02	.85	2	2.0
February---	59.4	29.1	44.3	87	8	57	.79	.09	1.32	2	3.0
March------	68.3	36.3	52.3	94	12	181	1.05	.13	1.77	3	1.0
April------	78.6	47.8	63.2	97	25	396	2.20	.38	3.61	3	.1
May--------	86.0	57.5	71.8	105	37	676	4.07	1.28	6.35	6	.0
June-------	94.9	66.9	80.9	108	53	927	2.98	1.09	4.54	5	.0
July-------	98.9	70.7	84.8	109	59	1,079	1.87	.45	2.99	4	.0
August-----	97.8	68.7	83.3	109	56	1,032	2.03	.38	3.30	3	.0
September--	89.3	61.2	75.3	105	43	759	2.68	.51	4.37	4	.0
October----	78.9	49.0	64.0	98	30	434	2.25	.47	3.64	3	.0
November---	64.4	36.3	50.4	86	16	94	.88	.09	1.47	2	.7
December---	56.3	28.1	42.2	81	8	15	.73	---	1.26	2	1.7
Yearly:											
Average--	77.2	48.0	62.6	---	---	---	---	---	---	---	---
Extreme--	---	---	---	112	1	---	---	---	---	---	---
Total----	---	---	---	---	---	5,674	22.03	16.84	27.11	39	8.5

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-76 at Hollis, Oklahoma]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 5	April 14	April 19
2 years in 10 later than--	March 30	April 9	April 15
5 years in 10 later than--	March 19	March 30	March 30
First freezing temperature in fall:			
1 year in 10 earlier than--	November 6	October 30	October 17
2 years in 10 earlier than--	November 12	November 3	October 22
5 years in 10 earlier than--	November 22	November 11	November 1

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-76 at Hollis, Oklahoma]

Probability	Length of growing season if daily minimum temperature is--		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	221	203	188
8 years in 10	230	211	194
5 years in 10	248	225	208
2 years in 10	265	239	221
1 year in 10	274	246	228

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1	Abilene loam, 0 to 1 percent slopes	3,730	1.1
2	Abilene loam, 1 to 3 percent slopes	1,846	0.5
3	Acme-Vinson complex, 0 to 1 percent slopes	505	0.1
4	Acme-Vinson complex, 1 to 3 percent slopes	495	0.1
5	Altus fine sandy loam, 0 to 1 percent slopes	4,715	1.4
6	Altus fine sandy loam, 1 to 3 percent slopes	1,425	0.4
7	Aspermont silt loam, 1 to 3 percent slopes	13,630	4.0
8	Aspermont silt loam, 3 to 5 percent slopes	3,094	0.9
9	Aspermont silt loam, 5 to 8 percent slopes	988	0.3
10	Beckman silty clay, occasionally flooded	425	0.1
11	Carey loam, 1 to 3 percent slopes	1,117	0.3
12	Clairemont silt loam, occasionally flooded	1,515	0.4
13	Cornick-Vinson-Rock outcrop complex, 1 to 5 percent slopes	4,126	1.2
14	Devol loamy fine sand, 0 to 3 percent slopes	9,890	2.9
15	Devol loamy fine sand, 3 to 8 percent slopes	6,812	2.0
16	Devol loamy fine sand, 3 to 8 percent slopes, eroded	4,535	1.3
17	Devol fine sandy loam, 1 to 3 percent slopes	713	0.2
18	Gracemont fine sandy loam, saline, frequently flooded	1,760	0.5
19	Gracemore loam, saline, frequently flooded	2,115	0.6
20	Grandfield loamy fine sand, 0 to 3 percent slopes	14,960	4.4
21	Grandfield loamy fine sand, 2 to 5 percent slopes, eroded	3,815	1.1
22	Grandfield fine sandy loam, 0 to 2 percent slopes	3,860	1.1
23	Grandfield fine sandy loam, 2 to 5 percent slopes, eroded	330	0.1
24	Grandmore loamy fine sand, 0 to 3 percent slopes	3,425	1.0
25	Hardeman fine sandy loam, 1 to 3 percent slopes	4,002	1.2
26	Hardeman fine sandy loam, 3 to 5 percent slopes	2,520	0.7
27	Hardeman fine sandy loam, 5 to 8 percent slopes	1,190	0.4
28	Hardeman fine sandy loam, 5 to 12 percent slopes, eroded	470	0.1
29	Hardeman fine sandy loam, 8 to 12 percent slopes	591	0.2
30	Hardeman-Likes-Devol complex, 3 to 20 percent slopes	4,435	1.3
31	Hollister silty clay loam, 0 to 1 percent slopes	3,525	1.0
32	Knoco-Aspermont complex, 3 to 12 percent slopes, gullied	1,360	0.4
33	Knoco-Badland association, gently sloping	10,615	3.1
34	Knoco-Cornick-Rock outcrop complex, 2 to 20 percent slopes	15,461	4.6
35	Knoco-Rock outcrop complex, 20 to 40 percent slopes	1,947	0.6
36	Likes fine sand, hummocky	1,208	0.4
37	Lincoln loamy fine sand, frequently flooded	2,395	0.7
38	Madge loam, 0 to 1 percent slopes	2,755	0.8
39	Madge loam, 1 to 3 percent slopes	10,405	3.1
40	Mangum silty clay loam, occasionally flooded	2,595	0.8
41	Mangum silty clay, rarely flooded	1,885	0.6
42	McKnight loamy fine sand, 0 to 3 percent slopes	4,447	1.3
43	McKnight loamy fine sand, 2 to 5 percent slopes, eroded	2,560	0.8
44	McKnight fine sandy loam, 1 to 3 percent slopes	3,575	1.1
45	Nobscot fine sand, 2 to 5 percent slopes	2,340	0.7
46	Nobscot fine sand, 5 to 12 percent slopes	2,169	0.6
47	Quanah-Talpa complex, 1 to 5 percent slopes	8,398	2.5
48	Quinlan-Rock outcrop complex, 12 to 45 percent slopes	4,605	1.4
49	Quinlan-Woodward complex, 3 to 5 percent slopes, eroded	3,710	1.1
50	Salt flats	90	*
51	Shrewder fine sandy loam, 1 to 3 percent slopes	1,917	0.6
52	Shrewder fine sandy loam, 3 to 5 percent slopes	1,100	0.3
53	Spur clay loam, occasionally flooded	2,090	0.6
54	Spur clay loam, frequently flooded	2,007	0.6
55	Tillman clay loam, 0 to 1 percent slopes	6,835	2.0
56	Tillman clay loam, 1 to 3 percent slopes	27,345	8.2
57	Tipton loam, 0 to 1 percent slopes	9,040	2.7
58	Tipton loam, 1 to 3 percent slopes	1,470	0.4
59	Tivoli fine sand	2,355	0.7
60	Likes-Devol complex, 3 to 12 percent slopes, gullied	1,480	0.4
61	Ustorthents, sandy	100	*
62	Vernon clay loam, 1 to 3 percent slopes	22,260	6.7
63	Vernon clay loam, 3 to 5 percent slopes	3,974	1.2
64	Vernon clay loam, 2 to 5 percent slopes, eroded	5,440	1.6
65	Vernon-Knoco complex, 1 to 12 percent slopes	18,252	5.4
66	Westview silty clay loam, 0 to 1 percent slopes	3,680	1.1
67	Woodward loam, 1 to 3 percent slopes	2,860	0.8
68	Woodward loam, 3 to 5 percent slopes	500	0.1
69	Woodward-Quinlan complex, 1 to 3 percent slopes	2,380	0.7
70	Woodward-Quinlan complex, 3 to 5 percent slopes	8,483	2.5

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
71	Woodward-Quinlan complex, 5 to 12 percent slopes	21,669	6.5
72	Yahola fine sandy loam, rarely flooded	490	0.1
73	Yahola fine sandy loam, occasionally flooded	4,304	1.3
	Total	339,110	100.0

* Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF CROPS

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Map symbol and soil name	Wheat	Cotton lint	Grain sorghum	Alfalfa hay
	Bu	Lb	Bu	Tons
1------------------------- Abilene	25	350	35	3.0
2------------------------- Abilene	25	275	30	3.0
3------------------------- Acme-Vinson	18	200	28	---
4------------------------- Acme-Vinson	16	190	24	
5------------------------- Altus	30	400	50	3.0
6------------------------- Altus	25	350	45	2.5
7------------------------- Aspermont	20	200	25	---
8------------------------- Aspermont	15	150	20	---
9------------------------- Aspermont	---	---	---	---
10------------------------ Beckman	10	100	18	---
11------------------------ Carey	20	275	30	2.5
12------------------------ Clairemont	30	450	50	4.0
13------------------------ Cornick-Vinson-Rock outcrop	---	---	---	---
14------------------------ Devol	20	250	30	2.5
15------------------------ Devol	15	200	25	---
16------------------------ Devol	10	150	20	---
17------------------------ Devol	20	250	30	---
18------------------------ Gracemont	---	---	---	---
19------------------------ Gracemore	---	---	---	---
20------------------------ Grandfield	20	250	30	2.0
21------------------------ Grandfield	10	150	20	---
22------------------------ Grandfield	20	300	30	2.0

TABLE 5.--YIELDS PER ACRE OF CROPS--Continued

Map symbol and soil name	Wheat	Cotton lint	Grain sorghum	Alfalfa hay
	Bu	Lb	Bu	Tons
23----------------------- Grandfield	15	150	15	---
24----------------------- Grandmore	20	275	35	2.5
25----------------------- Hardeman	23	275	30	2.0
26----------------------- Hardeman	18	225	28	---
27----------------------- Hardeman	10	---	20	---
28----------------------- Hardeman	---	---	---	---
29----------------------- Hardeman	---	---	---	---
30----------------------- Hardeman-Likes-Devol	---	---	---	---
31----------------------- Hollister	25	250	30	---
32----------------------- Knoco-Aspermont	---	---	---	---
33----------------------- Knoco-Badland	---	---	---	---
34----------------------- Knoco-Cornick-Rock outcrop	---	---	---	---
35----------------------- Knoco-Rock outcrop	---	---	---	---
36----------------------- Likes	---	---	---	---
37----------------------- Lincoln	---	---	---	---
38----------------------- Madge	30	350	40	3.0
39----------------------- Madge	25	300	35	2.5
40----------------------- Mangum	20	225	25	---
41----------------------- Mangum	15	225	20	---
42----------------------- McKnight	20	250	30	1.0
43----------------------- McKnight	10	150	20	0.5
44----------------------- McKnight	20	300	30	1.0

TABLE 5.--YIELDS PER ACRE OF CROPS--Continued

Map symbol and soil name	Wheat	Cotton lint	Grain sorghum	Alfalfa hay
	Bu	Lb	Bu	Tons
45 Nobscot	15	200	25	
46 Nobscot	---	---	---	---
47 Quanah-Talpa	---	---	---	---
48 Quinlan-Rock outcrop	---	---	---	---
49 Quinlan-Woodward	10	100	18	---
50 Salt flats	---	---	---	---
51 Shrewder	25	275	30	2.0
52 Shrewder	20	225	25	1.5
53 Spur	30	450	50	4.0
54 Spur	---	---	---	---
55 Tillman	25	250	30	---
56 Tillman	20	225	28	---
57 Tipton	30	375	45	3.5
58 Tipton	25	300	40	3.0
59 Tivoli	---	---	---	---
60 Likes-Devol	---	---	---	---
61 Ustorthents	---	---	---	---
62 Vernon	18	200	17	---
63 Vernon	13	150	14	---
64 Vernon	10	150	14	---
65 Vernon-Knoco	---	---	---	---
66 Westview	25	300	40	3.0
67 Woodward	20	300	30	---
68 Woodward	15	250	25	---

TABLE 5.--YIELDS PER ACRE OF CROPS--Continued

Map symbol and soil name	Wheat	Cotton lint	Grain sorghum	Alfalfa hay
	Bu	Lb	Bu	Tons
69------------------------ Woodward-Quinlan	20	300	30	---
70------------------------ Woodward-Quinlan	15	200	25	---
71------------------------ Woodward-Quinlan	---	---	---	---
72------------------------ Yahola	30	450	55	3.5
73------------------------ Yahola	30	425	50	3.5

TABLE 6.--YIELDS PER ACRE OF PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Map symbol and soil name	Improved bermudagrass	Weeping lovegrass	Caucasian bluestem	Plains bluestem	Forage sorghum	Small grain grazeout
	AUM*	AUM*	AUM*	AUM*	AUM*	AUM*
1----- Abilene	5.5	5.5	7.7	6.6	5.5	3.3
2----- Abilene	5.0	5.0	7.0	6.0	4.8	3.3
3----- Acme-Vinson	3.7	---	5.25	4.5	4.5	2.3
4----- Acme-Vinson	3.7	---	5.25	4.5	4.0	2.3
5----- Altus	6.0	6.5	7.2	6.5	8.0	4.0
6----- Altus	5.5	6.0	6.6	6.0	7.2	3.3
7----- Aspermont	4.0	4.0	4.8	4.0	4.0	2.6
8----- Aspermont	3.5	3.5	4.2	3.5	3.2	2.0
9----- Aspermont	3.0	3.0	3.6	3.0	---	---
10----- Beckman	3.0	3.0	3.6	3.0	2.8	1.5
11----- Carey	5.0	5.0	7.0	6.0	4.8	2.6
12----- Clairemont	7.5	7.5	8.0	7.5	8.0	4.0
13----- Cornick-Vinson-Rock outcrop	---	---	---	---	---	---
14----- Devol	5.5	6.0	6.6	6.0	4.8	2.6
15----- Devol	4.5	5.0	5.4	5.0	4.0	2.0
16----- Devol	4.5	5.0	5.4	5.0	3.2	2.0
17----- Devol	5.0	5.5	6.0	5.5	4.8	2.6
18----- Gracemont	5.5	---	---	---	---	---
19----- Gracemore	5.5	---	---	---	---	---
20----- Grandfield	4.5	5.5	6.3	5.5	4.8	2.6
21----- Grandfield	3.5	4.5	4.9	4.5	3.2	1.3

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF PASTURE--Continued

Map symbol and soil name	Improved bermudagrass	Weeping lovegrass	Caucasian bluestem	Plains bluestem	Forage sorghum	Small grain grazeout
	AUM*	AUM*	AUM*	AUM*	AUM*	AUM*
22 Grandfield	5.0	6.0	7.0	6.0	4.8	2.6
23 Grandfield	3.0	4.0	4.2	4.0	2.4	2.0
24 Grandmore	5.5	6.0	6.6	6.0	5.6	2.6
25 Hardeman	6.0	6.5	7.2	6.5	4.8	3.0
26 Hardeman	5.5	6.0	6.6	6.0	4.5	2.3
27 Hardeman	5.0	5.0	6.0	5.0	3.2	1.3
28 Hardeman	4.0	4.0	4.8	4.0	---	---
29 Hardeman	4.0	4.0-	4.8	4.0	---	---
30 Hardeman-Likes-Devol	3.0	3.0	3.6	3.0	---	---
31 Hollister	6.0	5.5	7.2	6.5	4.8	3.3
32 Knoco-Aspermont	---	---	---	---	---	---
33 Knoco-Badland	---	---	---	---	---	---
34 Knoco-Cornick-Rock outcrop	---	---	---	---	---	---
35 Knoco-Rock outcrop	---	---	---	---	---	---
36 Likes	3.0	3.5	4.2	3.5	---	---
37 Lincoln	5.5	6.0	6.6	6.0	---	2.3
38 Madge	5.5	6.5	7.0	6.5	6.4	4.0
39 Madge	5.0	6.0	6.5	6.0	5.6	3.3
40 Mangum	---	---	---	---	4.0	2.6
41 Mangum	---	---	---	---	3.2	2.0
42 McKnight	4.0	5.0	5.6	5.0	4.8	2.6
43 McKnight	3.0	4.0	4.2	4.0	3.2	1.3

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF PASTURE--Continued

Map symbol and soil name	Improved bermudagrass	Weeping lovegrass	Caucasian bluestem	Plains bluestem	Forage sorghum	Small grain grazeout
	AUM*	AUM*	AUM*	AUM*	AUM*	AUM*
44---------------------- McKnight	4.0	5.0	5.6	5.0	4.8	2.6
45---------------------- Nobscot	4.0	4.5	5.6	4.5	4.0	2.0
46---------------------- Nobscot	3.5	4.5	4.9	4.5	---	---
47---------------------- Quanah-Talpa	3.0	3.0	3.6	3.0	---	---
48---------------------- Quinlan-Rock outcrop	---	---	---	---	---	---
49---------------------- Quinlan-Woodward	4.0	4.0	5.0	4.0	2.8	1.3
50---------------------- Salt flats	---	---	---	---	---	---
51---------------------- Shrewder	5.0	6.0	7.0	6.0	4.8	3.3
52---------------------- Shrewder	4.5	5.5	6.3	5.5	4.0	2.6
53---------------------- Spur	7.5	7.5	8.5	8.0	8.0	4.0
54---------------------- Spur	7.0	7.0	8.0	7.5	---	---
55---------------------- Tillman	4.5	4.5	6.3	5.5	4.8	3.3
56---------------------- Tillman	4.0	4.0	5.6	4.8	4.5	2.6
57---------------------- Tipton	6.5	6.5	7.5	7.0	7.2	4.0
58---------------------- Tipton	5.5	6.0	6.5	6.0	6.4	3.3
59---------------------- Tivoli	---	---	---	---	---	---
60---------------------- Likes-Devol	5.0	5.5	6.0	5.5	---	---
61---------------------- Ustorthents	---	---	---	---	---	---
62---------------------- Vernon	3.5	---	4.5	4.0	2.6	2.3
63---------------------- Vernon	3.0	---	4.0	3.5	2.3	1.6
64---------------------- Vernon	3.0	---	4.0	3.5	2.3	1.3
65---------------------- Vernon-Knoco	---	---	---	---	---	---
66---------------------- Westview	6.0	---	7.2	6.5	6.4	3.3

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF PASTURE--Continued

Map symbol and soil name	Improved bermudagrass	Weeping lovegrass	Caucasian bluestem	Plains bluestem	Forage sorghum	Small grain grazeout
	AUM*	AUM*	AUM*	AUM*	AUM*	AUM*
67------------------------ Woodward	5.0	6.0	7.0	6.0	4.8	2.6
68------------------------ Woodward	4.5	5.5	6.3	5.5	4.0	2.0
69------------------------ Woodward-Quinlan	5.0	6.0	7.0	6.0	4.8	2.6
70------------------------ Woodward-Quinlan	4.5	5.0	6.0	5.0	4.0	2.0
71------------------------ Woodward-Quinlan	3.0	3.5	4.2	3.5	---	---
72------------------------ Yahola	7.5	7.5	8.5	8.0	8.8	4.0
73------------------------ Yahola	7.5	7.5	8.5	8.0	8.0	4.0

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 7.--RANGELAND PRODUCTIVITY

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Map symbol and soil name	Range site name	Potential annual production and kind of year		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
1, 2------------- Abilene	Hardland---------------------	2,700	1,900	1,300
3*, 4*:				
Acme-------------	Shallow Prairie---------------	2,300	1,600	1,200
Vinson------------	Loamy Prairie-----------------	4,000	2,800	2,000
5, 6------------- Altus	Sandy Prairie-----------------	4,000	2,800	2,000
7, 8, 9----------- Aspermont	Hardland---------------------	2,700	1,900	1,300
10--------------- Beckman	Heavy Bottomland (moderately alkaline)	3,000	2,100	1,500
11--------------- Carey	Loamy Prairie-----------------	4,000	2,800	2,000
12--------------- Clairemont	Loamy Bottomland--------------	5,500	3,400	2,000
13*:				
Cornick-----------	Gyp--------------------------	1,600	1,100	800
Vinson------------	Loamy Prairie-----------------	4,000	2,800	2,000
Rock outcrop.				
14, 15, 16-------- Devol	Deep Sand--------------------	3,500	2,200	1,400
17--------------- Devol	Sandy Prairie-----------------	4,000	2,800	2,000
18--------------- Gracemont	Subirrigated (saline)---------	6,500	5,300	4,500
19--------------- Gracemore	Subirrigated (saline)---------	6,500	5,300	4,500
20, 21------------ Grandfield	Deep Sand--------------------	3,500	2,200	1,400
22, 23------------ Grandfield	Sandy Prairie-----------------	4,000	2,800	2,000
24--------------- Grandmore	Deep Sand--------------------	3,500	2,200	1,400
25, 26, 27, 28, 29- Hardeman	Sandy Prairie-----------------	4,000	2,800	2,000
30*:				
Hardeman----------	Sandy Prairie-----------------	4,000	2,800	2,000
Likes-------------	Deep Sand--------------------	3,500	2,200	1,400
Devol-------------	Sandy Prairie-----------------	4,000	2,800	2,000
31--------------- Hollister	Hardland---------------------	2,700	1,900	1,300

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY--Continued

Map symbol and soil name	Range site name	Potential annual production and kind of year: Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
32*:				
Knoco	Eroded Red Clay	1,400	900	600
Aspermont	Eroded Prairie	1,800	1,200	800
33*:				
Knoco	Red Clay Prairie	2,200	1,500	1,000
Badland	Eroded Red Clay	600	350	200
34*:				
Knoco	Red Clay Prairie	2,200	1,500	1,000
Cornick	Gyp	1,600	1,100	800
Rock outcrop.				
35*:				
Knoco	Breaks	1,600	1,250	1,000
Rock outcrop.				
36 Likes	Deep Sand	3,500	2,200	1,400
37 Lincoln	Sandy Bottomland	3,000	2,300	1,300
38, 39 Madge	Loamy Prairie	4,000	2,800	2,000
40, 41 Mangum	Heavy Bottomland	4,500	3,300	2,500
42, 43 McKnight	Deep Sand	3,500	2,200	1,400
44 McKnight	Sandy Prairie	4,000	2,800	2,000
45, 46 Nobscot	Deep Sand Savannah	3,900	2,800	2,000
47*:				
Quanah	Hardland	2,700	1,900	1,300
Talpa	Very Shallow	1,400	900	600
48*:				
Quinlan	Breaks	1,600	1,250	1,000
Rock outcrop.				
49*:				
Quinlan	Shallow Prairie	2,300	1,600	1,200
Woodward	Loamy Prairie	4,000	2,800	2,000
50*. Salt flats				
51, 52 Shrewder	Sandy Prairie	4,000	2,800	2,000

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY--Continued

Map symbol and soil name	Range site name	Potential annual production and kind of year: Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
53, 54 Spur	Loamy Bottomland	5,800	3,800	2,400
55, 56 Tillman	Hardland	2,700	1,900	1,300
57, 58 Tipton	Loamy Prairie	4,000	2,800	2,000
59 Tivoli	Dune	1,600	1,100	800
60*:				
Likes	Eroded Sandyland	2,400	1,650	1,000
Devol	Eroded Sandyland	2,400	1,650	1,000
61*. Ustorthents				
62, 63 Vernon	Red Clay Prairie	2,200	1,500	1,000
64 Vernon	Red Clay Prairie	2,000	1,300	800
65*:				
Vernon	Red Clay Prairie	2,200	1,500	1,000
Knoco	Red Clay Prairie	2,200	1,500	1,000
66 Westview	Loamy Prairie	4,000	2,800	2,000
67, 68 Woodward	Loamy Prairie	4,000	2,800	2,000
69*, 70*, 71*:				
Woodward	Loamy Prairie	4,000	2,800	2,000
Quinlan	Shallow Prairie	2,300	1,600	1,200
72, 73 Yahola	Loamy Bottomland	5,800	3,800	2,400

*See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Map symbol and soil name	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
1, 2. Abilene	Skunkbush sumac	Eastern redcedar, osageorange, Austrian pine, oriental arborvitae, common hackberry.	Chinese elm, honeylocust, red mulberry, Russian-olive.	---	---
3*, 4*:					
Acme	---	---	---	---	---
Vinson	Skunkbush sumac	Lilac, American plum.	Eastern redcedar, osageorange, Austrian pine, ponderosa pine, red mulberry.	Black locust, Chinese elm, honeylocust.	Eastern cottonwood.
5, 6. Altus	Skunkbush sumac	Lilac, American plum, Amur honeysuckle.	Eastern redcedar, ponderosa pine, Austrian pine.	Red mulberry, Chinese elm, black locust.	Eastern cottonwood, American sycamore.
7, 8, 9. Aspermont	Skunkbush sumac	Amur honeysuckle, American plum.	Eastern redcedar, oriental arborvitae, Austrian pine, Russian-olive, osageorange.	Black locust, Chinese elm, honeylocust.	---
10. Beckman	---	---	---	---	---
11. Carey	Skunkbush sumac	Amur honeysuckle, American plum.	Austrian pine, osageorange, eastern redcedar, oriental arborvitae, Russian-olive.	Chinese elm, honeylocust, black locust.	---
12. Clairemont	Skunkbush sumac	American plum, Amur honeysuckle.	Austrian pine, eastern redcedar, oriental arborvitae, ponderosa pine.	Autumn-olive, black locust, Chinese elm.	American sycamore, eastern cottonwood.
13*:					
Cornick	---	---	---	---	---
Vinson	Lilac, skunkbush sumac.	Eastern redcedar, oneseed juniper, Amur honeysuckle, redbud, Scotch pine.	Black locust, osageorange, Chinese elm, honeylocust, red mulberry.	---	---
Rock outcrop.					
14, 15, 16, 17. Devol	Skunkbush sumac, lilac.	American plum	Austrian pine, ponderosa pine, red mulberry, eastern redcedar, osageorange, Russian-olive.	Honeylocust, Chinese elm, black locust.	---
18. Gracemont	---	---	---	---	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
19. Gracemore	---	---	---	---	---
20, 21, 22, 23. Grandfield	Skunkbush sumac	American plum, lilac, Amur honeysuckle.	Austrian pine, eastern redcedar, ponderosa pine, red mulberry, Russian-olive.	Honeylocust, black locust, Chinese elm.	
24. Grandmore	Skunkbush sumac	American plum, Amur honeysuckle, lilac.	---	Austrian pine, eastern redcedar, red mulberry, honeylocust, ponderosa pine, Chinese elm.	Eastern cottonwood.
25, 26, 27, 28, 29. Hardeman	Skunkbush sumac	American plum	Green ash, Russian-olive, black locust, Austrian pine, eastern redcedar, ponderosa pine, Scotch pine, red mulberry, Chinese elm, osageorange.	---	---
30*:					
Hardeman	Skunkbush sumac	American plum	Green ash, Chinese elm, osageorange, Russian-olive, red mulberry, black locust, Austrian pine, eastern redcedar, ponderosa pine, Scotch pine.	---	---
Likes	Amur honeysuckle, lilac.	American plum, eastern redcedar, redbud, ponderosa pine, osageorange, Rocky Mountain juniper, black locust, red mulberry, oriental arborvitae.	Chinese elm	---	---
Devol	Skunkbush sumac, lilac.	American plum	Austrian pine, ponderosa pine, red mulberry, eastern redcedar, osageorange, Russian-olive.	Honeylocust, Chinese elm.	---
31. Hollister	Skunkbush sumac	Eastern redcedar, osageorange, Austrian pine, oriental arborvitae, common hackberry.	Chinese elm, honeylocust, red mulberry, Russian-olive.	---	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
32*:					
Knoco	---	---	---	---	---
Aspermont	Skunkbush sumac	Amur honeysuckle, American plum.	Eastern redcedar, oriental arborvitae, Austrian pine, Russian-olive, osageorange.	Black locust, Chinese elm, honeylocust.	---
33*:					
Knoco	---	---	---	---	---
Badland.					
34*:					
Knoco	---	---	---	---	---
Cornick	---	---	---	---	---
Rock outcrop.					
35*:					
Knoco	---	---	---	---	---
Rock outcrop.					
36 Likes	Skunkbush sumac	American plum, Amur honeysuckle, lilac, Austrian pine.	Eastern redcedar, oriental arborvitae, Russian-olive, osageorange.	Honeylocust	American sycamore, eastern cottonwood.
37 Lincoln	Skunkbush sumac	American plum, Amur honeysuckle, lilac.	Eastern redcedar, red mulberry, osageorange, Chinese elm, autumn-olive.	Black locust	Eastern cottonwood, American sycamore.
38, 39 Madge	Skunkbush sumac	American plum, Amur honeysuckle, lilac.	Eastern redcedar, Austrian pine, ponderosa pine, Scotch pine.	Black locust, Chinese elm, honeylocust.	---
40, 41 Mangum	Skunkbush sumac	Amur honeysuckle	Green ash, red mulberry, Austrian pine, eastern redcedar, osageorange.	Honeylocust, Chinese elm.	Eastern cottonwood.
42, 43, 44 McKnight	Skunkbush sumac	American plum, Amur honeysuckle, lilac.	Austrian pine, eastern redcedar, Russian-olive, red mulberry, ponderosa pine.	Honeylocust, black locust, Chinese elm.	---
45, 46 Nobscot	Lilac, Amur honeysuckle, skunkbush sumac.	American plum	Austrian pine, Scotch pine, eastern redcedar, Chinese elm, ponderosa pine, red mulberry, black locust, osageorange.	---	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
47*:					
Quanah	Skunkbush sumac	Amur honeysuckle, American plum.	Eastern redcedar, oriental arborvitae, Russian-olive, osageorange	Black locust, Chinese elm, honeylocust.	---
Talpa	---	---	---	---	---
48*:					
Quinlan	---	---	---	---	---
Rock outcrop.					
49*:					
Quinlan	Skunkbush sumac, lilac, Amur honeysuckle.	Eastern redcedar, oriental arborvitae, Rocky Mountain juniper, osageorange, redbud.	---	---	---
Woodward	Skunkbush sumac	American plum, lilac.	Austrian pine, autumn-olive, Scotch pine, ponderosa pine, oriental arborvitae, osageorange, eastern redcedar.	Chinese elm, black locust.	---
50. Salt flats					
51, 52 Shrewder	Skunkbush sumac, lilac.	American plum, Amur honeysuckle.	Eastern redcedar, Scotch pine, honey locust, Chinese elm, Austrian pine, ponderosa pine, black locust.	---	---
53, 54 Spur	Skunkbush sumac	American plum, Amur honeysuckle.	Austrian pine, eastern redcedar, oriental arborvitae, ponderosa pine.	Autumn-olive, black locust, Chinese elm.	American sycamore, eastern cottonwood.
55, 56 Tillman	Skunkbush sumac	Eastern redcedar, common hackberry, Austrian pine, osageorange, oriental arborvitae.	Red mulberry, honeylocust, Chinese elm, Russian-olive.	---	---
57, 58 Tipton	Skunkbush sumac	American plum, lilac.	Austrian pine, eastern redcedar, ponderosa pine, Scotch pine.	Red mulberry, osageorange, black locust.	Eastern cottonwood, American sycamore.
59 Tivoli	---	---	---	---	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
60*: Likes	Amur honeysuckle, lilac.	American plum, eastern redcedar, redbud, ponderosa pine, osageorange, Rocky Mountain juniper, black locust, red mulberry, oriental arborvitae.	Chinese elm	---	---
Devol	Skunkbush sumac, lilac.	American plum	Austrian pine, ponderosa pine, red mulberry, eastern redcedar, osageorange, Russian-olive.	Honeylocust, Chinese elm, black locust.	---
61. Ustorthents					
62, 63, 64 Vernon	Skunkbush sumac	Eastern redcedar, osageorange.	Chinese elm, honeylocust.	---	---
65*: Vernon	Skunkbush sumac	Eastern redcedar, osageorange.	Chinese elm, honeylocust.	---	---
Knoco	---	---	---	---	---
66 Westview	Skunkbush sumac	American plum, Amur honeysuckle, lilac.	Austrian pine, ponderosa pine, eastern redcedar.	Honeylocust, red mulberry, Chinese elm, black locust.	Eastern cottonwood.
67, 68 Woodward	Skunkbush sumac	American plum, lilac.	Austrian pine, autumn-olive, Scotch pine, ponderosa pine, oriental arborvitae, osageorange, eastern redcedar.	Chinese elm, black locust.	---
69*, 70*, 71*: Woodward	Skunkbush sumac	American plum, lilac.	Austrian pine, autumn-olive, Scotch pine, ponderosa pine, oriental arborvitae, osageorange, eastern redcedar.	Chinese elm, black locust.	---
Quinlan	Skunkbush sumac, lilac, Amur honeysuckle.	Eastern redcedar, oriental arborvitae, Rocky Mountain juniper, osageorange, redbud.	---	---	---
72, 73 Yahola	Skunkbush sumac	American plum, lilac.	Austrian pine, eastern redcedar, ponderosa pine, Scotch pine.	Red mulberry, osageorange, Chinese elm.	Eastern cottonwood, American sycamore.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1 Abilene	Slight	Slight	Slight	Severe: erodes easily.	Slight.
2 Abilene	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
3*:					
Acme	Slight	Slight	Slight	Severe: erodes easily.	Severe: thin layer.
Vinson	Slight	Slight	Slight	Severe: erodes easily.	Moderate: thin layer.
4*:					
Acme	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Severe: thin layer.
Vinson	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Moderate: thin layer.
5 Altus	Slight	Slight	Slight	Slight	Slight.
6 Altus	Slight	Slight	Moderate: slope.	Slight	Slight.
7, 8 Aspermont	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
9 Aspermont	Slight	Slight	Severe: slope.	Severe: erodes easily.	Slight.
10 Beckman	Severe: flooding, excess salt.	Severe: excess salt.	Severe: excess salt.	Severe: erodes easily.	Severe: too clayey.
11 Carey	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
12 Clairemont	Severe: flooding.	Slight	Moderate: flooding.	Severe: erodes easily.	Moderate: flooding.
13*:					
Cornick	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: erodes easily.	Severe: thin layer, droughty.
Vinson	Slight	Slight	Moderate: slope, depth to rock.	Severe: erodes easily.	Moderate: thin layer.
Rock outcrop.					
14, 17 Devol	Slight	Slight	Moderate: slope.	Slight	Slight.
15, 16 Devol	Slight	Slight	Severe: slope.	Slight	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
18: Gracemont	Severe: flooding, wetness, excess salt.	Severe: wetness, excess salt.	Severe: wetness, flooding, excess salt.	Severe: wetness.	Severe: excess salt, wetness, flooding.
19: Gracemore	Severe: flooding, wetness, excess salt.	Severe: wetness, excess salt.	Severe: wetness, flooding, excess salt.	Severe: wetness.	Severe: excess salt, wetness, flooding.
20: Grandfield	Slight	Slight	Moderate: slope.	Slight	Slight.
21: Grandfield	Slight	Slight	Moderate: slope.	Slight	Slight.
22: Grandfield	Slight	Slight	Slight	Slight	Slight.
23: Grandfield	Slight	Slight	Moderate: slope.	Slight	Slight.
24: Grandmore	Slight	Slight	Moderate: slope.	Slight	Slight.
25, 26: Hardeman	Slight	Slight	Moderate: slope.	Slight	Slight.
27: Hardeman	Slight	Slight	Severe: slope.	Slight	Slight.
28, 29: Hardeman	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
30*:					
Hardeman	Severe: slope.	Severe: slope.	Severe: slope.	Slight	Severe: slope.
Likes	Severe: slope.	Severe: slope.	Severe: small stones, slope.	Moderate: too sandy, slope.	Severe: slope.
Devol	Severe: slope.	Severe: slope.	Severe: slope.	Slight	Severe: slope.
31: Hollister	Slight	Slight	Slight	Slight	Slight.
32*:					
Knoco	Severe: depth to bedrock.	Severe: depth to bedrock.	Severe: slope, depth to bedrock, too clayey.	Severe: erodes easily.	Severe: droughty, too clayey, thin layer.
Aspermont	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
33*:					
Knoco	Severe: depth to bedrock.	Severe: depth to bedrock.	Severe: depth to bedrock, too clayey, slope.	Severe: erodes easily.	Severe: droughty, too clayey, thin layer.
Badland.					

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
34*:					
Knoco	Severe: slope, depth to bedrock.	Severe: slope, depth to bedrock.	Severe: slope, depth to bedrock, too clayey.	Severe: erodes easily.	Severe: droughty, slope, too clayey, thin layer.
Cornick	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.	Severe: thin layer, droughty.
Rock outcrop.					
35*:					
Knoco	Severe: slope, depth to bedrock.	Severe: slope, depth to bedrock.	Severe: slope, depth to bedrock, too clayey.	Severe: slope, erodes easily.	Severe: droughty, slope, too clayey, thin layer.
Rock outcrop.					
36 Likes	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Severe: droughty.
37 Lincoln	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: droughty, flooding.
38 Madge	Slight	Slight	Slight	Severe: erodes easily.	Slight.
39 Madge	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
40 Mangum	Severe: flooding.	Moderate: percs slowly.	Moderate: too clayey, flooding, percs slowly.	Slight	Moderate: flooding.
41 Mangum	Severe: flooding.	Moderate: too clayey, percs slowly.	Severe: too clayey.	Severe: erodes easily.	Severe: too clayey.
42 McKnight	Slight	Slight	Moderate: slope.	Slight	Slight.
43, 44 McKnight	Slight	Slight	Moderate: slope.	Slight	Slight.
45 Nobscot	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty.
46 Nobscot	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Moderate: droughty, slope.
47*:					
Quanah	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
Talpa	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, depth to rock.	Slight	Severe: thin layer.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
48*:					
Quinlan	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, thin layer.
Rock outcrop.					
49*:					
Quinlan	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Severe: thin layer.
Woodward	Slight	Slight	Moderate: slope, depth to rock.	Severe: erodes easily.	Moderate: thin layer.
50. Salt flats					
51, 52 Shrewder	Slight	Slight	Moderate: slope.	Slight	Slight.
53 Spur	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
54 Spur	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
55 Tillman	Slight	Slight	Slight	Severe: erodes easily.	Slight.
56 Tillman	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
57 Tipton	Slight	Slight	Slight	Severe: erodes easily.	Slight.
58 Tipton	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
59 Tivoli	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Severe: droughty, slope.
60*:					
Likes	Moderate: small stones, slope.	Moderate: small stones, slope.	Severe: small stones, slope.	Slight	Moderate: droughty, slope.
Devol	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
61. Ustorthents					
62, 63, 64 Vernon	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Severe: erodes easily.	Moderate: thin layer, droughty.
65*:					
Vernon	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: droughty, slope, thin layer.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
65*:					
Knoco	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, too clayey, depth to rock.	Severe: erodes easily.	Severe: droughty, too clayey, thin layer.
66 Westview	Slight	Slight	Slight	Slight	Slight.
67, 68 Woodward	Slight	Slight	Moderate: slope, depth to rock.	Severe: erodes easily.	Moderate: thin layer.
69*, 70*:					
Woodward	Slight	Slight	Moderate: slope, depth to rock.	Severe: erodes easily.	Moderate: thin layer.
Quinlan	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Severe: thin layer.
71*:					
Woodward	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: thin layer, slope.
Quinlan	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight	Severe: thin layer.
72 Yahola	Severe: flooding.	Slight	Slight	Slight	Slight.
73 Yahola	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for: Openland wildlife	Wetland wildlife	Rangeland wildlife
1, 2. Abilene	Good	Good	Fair	Good	Poor	Very poor.	Good	Very poor.	Fair.
3*, 4*:									
Acme	Poor	Poor	Fair	Fair	Poor	Very poor.	Poor	Very poor.	Fair.
Vinson	Fair	Good	Good	Fair	Poor	Very poor.	Good	Very poor.	Fair.
5, 6. Altus	Good	Good	Good	Good	Poor	Very poor.	Good	Very poor.	Good.
7, 8. Aspermont	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Very poor.	Fair.
9. Aspermont	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Very poor.	Fair.
10. Beckman	Fair	Fair	Poor	Fair	Poor	Poor	Fair	Poor	Poor.
11. Carey	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Very poor.	Fair.
12. Clairemont	Good	Good	Fair	Good	Very poor.	Very poor.	Good	---	Fair.
13*:									
Cornick	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Very poor.
Vinson	Fair	Good	Good	Fair	Poor	Very poor.	Good	Very poor.	Fair.
Rock outcrop.									
14, 15, 16. Devol	Fair	Fair	Good	Fair	Poor	Very poor.	Fair	Very poor.	Fair.
17. Devol	Good	Good	Good	Fair	Poor	Very poor.	Good	Very poor.	Fair.
18. Gracemont	Poor	Fair	Very poor.	Poor	Fair	Poor	Poor	Poor	Poor.
19. Gracemore	Poor	Very poor.	Poor	Poor	Fair	Fair	Poor	Fair	Poor.
20. Grandfield	Fair	Fair	Good	Good	Poor	Very poor.	Fair	Very poor.	Good.
21. Grandfield	Fair	Good	Good	Good	Poor	Very poor.	Fair	Very poor.	Good.
22. Grandfield	Good	Good	Good	Good	Poor	Very poor.	Good	Very poor.	Good.
23. Grandfield	Fair	Good	Good	Good	Poor	Very poor.	Fair	Very poor.	Good.
24. Grandmore	Fair	Fair	Good	Good	Poor	Very poor.	Fair	Very poor.	Good.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for: Openland wildlife	Wetland wildlife	Rangeland wildlife
25, 26 Hardeman	Good	Good	Good	Good	Very poor.	Very poor.	Good	Very poor.	Good.
27, 28, 29 Hardeman	Fair	Good	Good	Good	Very poor.	Very poor.	Good	Very poor.	Good.
30*:									
Hardeman	Fair	Good	Good	Good	Very poor.	Very poor.	Good	Very poor.	Good.
Likes	Poor	Poor	Fair	Poor	Very poor.	Very poor.	Fair	Very poor.	Poor.
Devol	Fair	Good	Good	Fair	Very poor.	Very poor.	Good	Very poor.	Fair.
31 Hollister	Good	Good	Fair	Fair	Poor	Very poor.	Good	Very poor.	Fair.
32*:									
Knoco	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Aspermont	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Very poor.	Fair.
33*:									
Knoco	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Badland.									
34*:									
Knoco	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Cornick	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Very poor.
Rock outcrop.									
35*:									
Knoco	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Rock outcrop.									
36 Likes	Poor	Poor	Fair	Poor	Very poor.	Very poor.	Poor	Very poor.	Poor.
37 Lincoln	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Very poor.	Fair.
38, 39 Madge	Good	Good	Good	Good	Poor	Very poor.	Good	Very poor.	Good.
40 Mangum	Good	Good	Fair	Fair	Poor	Poor	Good	Poor	Fair.
41 Mangum	Fair	Fair	Poor	Fair	Poor	Poor	Fair	Poor	Poor.
42 McKnight	Fair	Fair	Good	Good	Poor	Very poor.	Fair	Very poor.	Good.
43 McKnight	Fair	Fair	Good	Good	Poor	Very poor.	Fair	Very poor.	Good.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for: Openland wildlife	Wetland wildlife	Rangeland wildlife
44------ McKnight	Good	Good	Good	Good	Poor	Very poor.	Good	Very poor.	Good.
45, 46------ Nobscot	Fair	Fair	Good	Good	Poor	Very poor.	Fair	Very poor.	Good.
47*:									
Quanah------	Good	Good	Fair	Fair	Poor	Very poor.	Good	Very poor.	Fair.
Talpa------	Very poor.	Very poor.	Fair	Fair	Very poor.	Very poor.	Poor	Very poor.	Fair.
48*:									
Quinlan------	Very poor.	Very poor.	Fair	Poor	Very poor.	Very poor.	Poor	Very poor.	Poor.
Rock outcrop.									
49*:									
Quinlan------	Poor	Poor	Fair	Poor	Poor	Very poor.	Fair	Very poor.	Poor.
Woodward------	Fair	Good	Good	Fair	Poor	Very poor.	Good	Very poor.	Fair.
50. Salt flats									
51, 52------ Shrewder	Good	Good	Good	Good	Poor	Very poor.	Good	Very poor.	Good.
53------ Spur	Good	Good	Good	Good	Very poor.	Very poor.	Good	Very poor.	Good.
54------ Spur	Very poor.	Poor	Fair	Good	Very poor.	Very poor.	Poor	Very poor.	Fair.
55, 56------ Tillman	Good	Good	Fair	Fair	Poor	Very poor.	Good	Very poor.	Fair.
57, 58------ Tipton	Good	Good	Good	Good	Poor	Very poor.	Good	Very poor.	Good.
59------ Tivoli	Poor	Poor	Fair	Poor	Very poor.	Very poor.	Poor	Very poor.	Poor.
60*:									
Likes------	Very poor.	Very poor.	Fair	Poor	Very poor.	Very poor.	Poor	Very poor.	Poor.
Devol------	Fair	Fair	Good	Fair	Very poor.	Very poor.	Fair	Very poor.	Fair.
61. Ustorthents									
62, 63, 64------ Vernon	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Very poor.	Fair.
65*:									
Vernon------	Fair	Fair	Poor	Fair	Poor	Very poor.	Fair	Very poor.	Fair.
Knoco------	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for: Openland wildlife	Wetland wildlife	Rangeland wildlife
66------------------ Westview	Good	Good	Fair	Fair	Poor	Very poor.	Good	Very poor.	Fair.
67, 68------------- Woodward	Fair	Good	Good	Fair	Poor	Very poor.	Good	Very poor.	Fair.
69*, 70*:									
Woodward-----------	Fair	Good	Good	Fair	Poor	Very poor.	Good	Very poor.	Fair.
Quinlan------------	Poor	Poor	Fair	Poor	Poor	Very poor.	Fair	Very poor.	Poor.
71*:									
Woodward-----------	Fair	Good	Good	Fair	Very poor.	Very poor.	Good	Very poor.	Fair.
Quinlan------------	Poor	Poor	Fair	Poor	Very poor.	Very poor.	Fair	Very poor.	Poor.
72, 73------------- Yahola	Good	Good	Good	Good	Poor	Very poor.	Good	Very poor.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1, 2--------------- Abilene	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Slight.
3*, 4*:						
Acme---------------	Slight---------	Slight---------	Slight---------	Slight---------	Slight---------	Severe: thin layer.
Vinson-------------	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: thin layer.
5, 6--------------- Altus	Slight---------	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
7------------------ Aspermont	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Slight.
8, 9--------------- Aspermont	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Moderate: shrink-swell.	Slight.
10----------------- Beckman	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: too clayey.
11----------------- Carey	Slight---------	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
12----------------- Clairemont	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
13*:						
Cornick------------	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock.	Severe: thin layer, droughty.
Vinson-------------	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell.	Moderate: thin layer.
Rock outcrop.						
14----------------- Devol	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
15, 16------------- Devol	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Slight.
17----------------- Devol	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
18----------------- Gracemont	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: excess salt, wetness, flooding.
19----------------- Gracemore	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: excess salt, wetness, flooding.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
20 Grandfield	Slight	Slight	Slight	Slight	Slight	Slight.
21, 23 Grandfield	Slight	Slight	Slight	Moderate: slope.	Slight	Slight.
22 Grandfield	Slight	Slight	Slight	Slight	Slight	Slight.
24 Grandmore	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Slight	Slight.
25 Hardeman	Slight	Slight	Slight	Slight	Slight	Slight.
26, 27 Hardeman	Slight	Slight	Slight	Moderate: slope	Slight	Slight.
28, 29 Hardeman	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
30*:						
Hardeman	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Likes	Severe: cutbanks cave slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Devol	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
31 Hollister	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Slight.
32*:						
Knoco	Severe: depth to rock.	Severe: shrink-swell,	Severe: shrink-swell, depth to rock.	Severe: shrink-swell, slope.	Severe: shrink-swell.	Severe: droughty, too clayey, thin layer.
Aspermont	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, slope.	Moderate: slope.
33*:						
Knoco	Severe: depth to rock.	Severe: shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: shrink-swell, slope.	Severe: shrink-swell.	Severe: droughty, too clayey, thin layer.
Badland.						
34*:						
Knoco	Severe: slope, depth to rock.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell, depth to rock.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: droughty, slope, too clayey, thin layer.
Cornick	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.	Severe: thin layer, droughty.
Rock outcrop.						

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
35*:						
Knoco	Severe: slope, depth to rock.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell, depth to rock.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: droughty, slope, too clayey, thin layer.
Rock outcrop.						
36 Likes	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Severe: droughty.
37 Lincoln	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: droughty, flooding.
38, 39 Madge	Slight	Slight	Slight	Slight	Slight	Slight.
40 Mangum	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Moderate: flooding.
41 Mangum	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell.	Severe: too clayey.
42 McKnight	Moderate: too clayey.	Slight	Severe: shrink-swell.	Slight	Slight	Slight.
43 McKnight	Moderate: too clayey.	Slight	Severe: shrink-swell.	Moderate: slope.	Slight	Slight.
44 McKnight	Moderate: too clayey.	Slight	Severe: shrink-swell.	Slight	Slight	Slight.
45 Nobscot	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
46 Nobscot	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
47*:						
Quanah	Slight	Slight	Slight	Moderate: slope.	Slight	Slight.
Talpa	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe depth to rock.	Severe: thin layer.
48*:						
Quinlan	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
Rock outcrop.						
49*:						
Quinlan	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock, slope.	Moderate: depth to rock.	Severe: thin layer.
Woodward	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope.	Slight	Moderate: thin layer.
50. Salt flats						

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
51----------------- Shrewder	Slight---------	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
52----------------- Shrewder	Slight---------	Slight---------	Slight---------	Moderate: slope.	Slight---------	Slight.
53----------------- Spur	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
54----------------- Spur	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
55, 56------------- Tillman	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Slight.
57, 58------------- Tipton	Slight---------	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
59----------------- Tivoli	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
60*:						
Likes-------------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
Devol-------------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
61. Ustorthents						
62, 63, 64--------- Vernon	Moderate: too clayey, depth to rock.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Moderate: droughty, thin layer.
65*:						
Vernon------------	Moderate: too clayey, slope, depth to rock.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell.	Moderate: droughty, slope, thin layer.
Knoco-------------	Severe: depth to rock.	Severe: shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: shrink-swell, slope.	Severe: shrink-swell.	Severe: droughty, too clayey, thin layer.
66----------------- Westview	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Slight.
67----------------- Woodward	Moderate: depth to rock.	Slight---------	Moderate: depth to rock.	Slight---------	Slight---------	Moderate: thin layer.
68----------------- Woodward	Moderate: depth to rock.	Slight---------	Moderate: depth to rock.	Moderate: slope.	Slight---------	Moderate: thin layer.
69*:						
Woodward----------	Moderate: depth to rock.	Slight---------	Moderate: depth to rock.	Slight---------	Slight---------	Moderate: thin layer.
Quinlan-----------	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: thin layer.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
70*:						
Woodward	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope.	Slight	Moderate: thin layer.
Quinlan	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock, slope.	Moderate: depth to rock.	Severe: thin layer.
71*:						
Woodward	Moderate: depth to rock, slope.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.	Moderate: thin layer, slope.
Quinlan	Severe: depth to rock.	Moderate: depth to rock, slope.	Severe: depth to rock.	Severe: slope.	Moderate: slope, depth to rock.	Severe: thin layer.
72 Yahola	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
73 Yahola	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1 Abilene	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
2 Abilene	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
3*, 4*:					
Acme	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: area reclaim, thin layer.
Vinson	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: thin layer, area reclaim.
5, 6 Altus	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight	Good.
7, 8 Aspermont	Moderate: percs slowly, depth to rock.	Moderate: seepage, depth to rock, slope.	Severe: depth to rock.	Moderate: depth to rock.	Fair: too clayey, area reclaim.
9 Aspermont	Moderate: percs slowly, depth to rock.	Severe: slope.	Severe: depth to rock.	Moderate: depth to rock.	Fair: too clayey, area reclaim.
10 Beckman	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
11 Carey	Moderate: depth to rock, percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
12 Clairemont	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
13*:					
Cornick	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: thin layer, area reclaim.
Vinson	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
Rock outcrop.					
14, 17 Devol	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
15, 16 Devol	Slight	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
18 Gracemont	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
19----------------- Gracemore	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, wetness.
20, 21, 22, 23------ Grandfield	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight-----------	Good.
24----------------- Grandmore	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
25, 26------------- Hardeman	Slight-----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
27----------------- Hardeman	Slight-----------	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Good.
28, 29------------- Hardeman	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: slope.
30*:					
Hardeman-----------	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
Likes--------------	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, too sandy, slope.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
Devol--------------	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
31----------------- Hollister	Severe: percs slowly.	Slight-----------	Severe: too clayey.	Slight-----------	Poor: too clayey.
32*:					
Knoco--------------	Severe: percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, hard to pack, too clayey, area reclaim.
Aspermont----------	Moderate: slope, percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope, too clayey.
33*:					
Knoco--------------	Severe: percs slowly, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, hard to pack, thin layer, too clayey.
Badland.					
34*:					
Knoco--------------	Severe: percs slowly, slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock, too clayey.	Severe: slope, depth to rock.	Poor: area reclaim, hard to pack, slope, thin layer, too clayey.
Cornick------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: thin layer, area reclaim.
Rock outcrop.					

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
35*:					
Knoco	Severe: percs slowly, slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock, too clayey.	Severe: slope, depth to rock.	Poor: area reclaim, hard to pack, slope, thin layer, too clayey.
Rock outcrop.					
36 Likes	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
37 Lincoln	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage.	Poor: seepage, too sandy.
38, 39 Madge	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight	Fair: too clayey.
40 Mangum	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
41 Mangum	Severe: percs slowly.	Slight	Severe: too clayey.	Moderate: flooding.	Poor: too clayey, hard to pack.
42, 43, 44 McKnight	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Fair: area reclaim, thin layer.
45 Nobscot	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
46 Nobscot	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
47*:					
Quanah	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Talpa	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
48*:					
Quinlan	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope, thin layer.
Rock outcrop.					
49*:					
Quinlan	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
Woodward	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
50. Salt flats					
51, 52 Shrewder	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
53, 54 Spur	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
55 Tillman	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
56 Tillman	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
57 Tipton	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
58 Tipton	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
59 Tivoli	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
60*:					
Likes	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Devol	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: too sandy, slope.
61. Ustorthents					
62, 63, 64 Vernon	Severe: percs slowly, depth to rock.	Severe: depth to rock.	Severe: too clayey, depth to rock.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack, thin layer.
65*:					
Vernon	Severe: percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: too clayey, depth to rock.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack, thin layer.
Knoco	Severe: percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, hard to pack, too clayey, thin layer.
66 Westview	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
67, 68------------- Woodward	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
69*, 70*:					
Woodward-----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
Quinlan------------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
71*:					
Woodward-----------	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
Quinlan------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
72----------------- Yahola	Moderate: flooding.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
73----------------- Yahola	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1, 2. Abilene	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
3*, 4*:				
Acme	Poor: area reclaim, thin layer.	Improbable: excess fines, thin layer.	Improbable: excess fines, thin layer.	Poor: area reclaim, thin layer.
Vinson	Poor: thin layer, area reclaim.	Improbable: excess fines, thin layer.	Improbable: excess fines, thin layer.	Fair: thin layer, area reclaim.
5, 6. Altus	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
7, 8, 9. Aspermont	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
10. Beckman	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salts.
11. Carey	Fair: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
12. Clairemont	Slight	Improbable: excess fines.	Improbable: excess fines.	Good.
13*:				
Cornick	Poor: thin layer, area reclaim.	Improbable: excess fines, thin layer.	Improbable: excess fines, thin layer.	Poor: thin layer, area reclaim.
Vinson	Poor: area reclaim, thin layer.	Improbable: excess fines, thin layer.	Improbable: excess fines, thin layer.	Fair: area reclaim, thin layer.
Rock outcrop.				
14, 15, 16. Devol	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
17. Devol	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
18. Gracemont	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness.
19. Gracemore	Poor: wetness.	Probable	Improbable: too sandy.	Poor: excess salt, wetness.
20, 21. Grandfield	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
22, 23. Grandfield	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
24. Grandmore	Moderate: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
25, 26, 27 Hardeman	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
28, 29 Hardeman	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
30*:				
Hardeman	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Likes	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope, small stones.
Devol	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
31 Hollister	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
32*:				
Knoco	Poor: area reclaim, shrink-swell, thin layer.	Improbable: excess fines, thin layer.	Improbable: excess fines, thin layer.	Poor: area reclaim, too clayey, thin layer.
Aspermont	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, too clayey.
33*:				
Knoco	Poor: area reclaim, shrink-swell.	Improbable: excess fines, thin layer.	Improbable: excess fines, thin layer.	Poor: area reclaim, too clayey,
Badland.				
34*:				
Knoco	Poor: area reclaim, shrink-swell, thin layer.	Improbable: excess fines, thin layer.	Improbable: excess fines, thin layer.	Poor: area reclaim, too clayey, slope, thin layer.
Cornick	Poor: thin layer, area reclaim.	Improbable: excess fines, thin layer.	Improbable: excess fines, thin layer.	Poor: thin layer, area reclaim.
Rock outcrop.				
35*:				
Knoco	Poor: area reclaim, shrink-swell, slope, thin layer.	Improbable: excess fines, thin layer.	Improbable: excess fines, thin layer.	Poor: area reclaim, too clayey, slope, thin layer.
Rock outcrop.				
36 Likes	Good	Probable	Improbable: too sandy, excess fines.	Poor: too sandy.
37 Lincoln	Good	Probable	Improbable: too sandy.	Fair: too sandy.
38, 39 Madge	Slight	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
40 Mangum	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
41 Mangum	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
42, 43, 44 McKnight	Fair: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
45, 46 Nobscot	Good	Probable	Improbable: too sandy.	Poor: too sandy.
47*:				
Quanah	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Talpa	Poor: area reclaim, thin layer.	Improbable: excess fines, thin layer.	Improbable: excess fines, thin layer.	Poor: area reclaim, small stones, thin layer.
48*:				
Quinlan	Poor: area reclaim, slope, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope, thin layer.
Rock outcrop.				
49*:				
Quinlan	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, thin layer.
Woodward	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
50. Salt flats				
51, 52 Shrewder	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
53, 54 Spur	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
55, 56 Tillman	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
57, 58 Tipton	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
59 Tivoli	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
60*:				
Likes	Good	Probable	Improbable: too sandy.	Poor: too sandy, small stones.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
60*:				
Devol	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, slope.
61. Ustorthents				
62, 63, 64 Vernon	Poor: area reclaim, shrink-swell, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
65*:				
Vernon	Poor: area reclaim, shrink-swell, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Knoco	Poor: area reclaim, shrink-swell, thin layer.	Improbable: excess fines, thin layer.	Improbable: excess fines, thin layer.	Poor: area reclaim, too clayey, thin layer.
66 Westview	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
67, 68 Woodward	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
69*, 70*:				
Woodward	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
Quinlan	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, thin layer.
71*:				
Woodward	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, area reclaim, thin layer.
Quinlan	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, thin layer.
72, 73 Yahola	Good	Improbable: excess fines.	Improbable: excess fines.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Map symbol and soil name	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Limitations for-- Aquifer-fed excavated ponds	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
1, 2. Abilene	Slight	Moderate: hard to pack.	Severe: no water.	Erodes easily	Erodes easily	Erodes easily.
3*, 4*:						
Acme	Severe: seepage.	Severe: thin layer.	Severe: no water.	Erodes easily	Erodes easily	Erodes easily.
Vinson	Severe: seepage.	Severe: thin layer.	Severe: no water.	Erodes easily	Erodes easily	Erodes easily.
5, 6. Altus	Moderate: seepage.	Severe: piping.	Severe: no water.	Soil blowing	Soil blowing	Favorable.
7. Aspermont	Moderate: seepage, depth to rock.	Moderate: thin layer.	Severe: no water.	Erodes easily	Erodes easily	Erodes easily.
8, 9. Aspermont	Moderate: seepage, slope depth to rock.	Moderate: thin layer.	Severe: no water.	Slope, erodes easily.	Erodes easily	Erodes easily.
10. Beckman	Slight	Moderate: hard to pack, excess salt.	Severe: no water.	Droughty, slow intake, percs slowly.	Percs slowly	Excess salt, droughty, percs slowly.
11. Carey	Moderate: seepage.	Severe: piping.	Severe: no water.	Erodes easily	Erodes easily	Erodes easily.
12. Clairemont	Moderate: seepage.	Severe: piping.	Severe: no water.	Erodes easily, flooding.	Erodes easily	Erodes easily.
13*:						
Cornick	Severe: depth to rock, seepage.	Severe: thin layer.	Severe: no water.	Depth to rock, slope, erodes easily.	Depth to rock, erodes easily.	Erodes easily, depth to rock droughty.
Vinson	Severe: seepage.	Severe: thin layer.	Severe: no water.	Depth to rock, slope, erodes easily.	Depth to rock, erodes easily.	Erodes easily, depth to rock
Rock outcrop.						
14. Devol	Severe: seepage.	Severe: piping.	Severe: no water.	Fast intake, soil blowing.	Too sandy, soil blowing.	Favorable.
15, 16. Devol	Severe: seepage.	Severe: piping.	Severe: no water.	Soil blowing, slope, fast intake.	Too sandy, soil blowing.	Favorable.
17. Devol	Severe: seepage.	Severe: piping.	Severe: no water.	Soil blowing	Too sandy, soil blowing.	Favorable.
18. Gracemont	Severe: seepage.	Severe: piping, wetness.	Moderate: slow refill, salty water.	Wetness, soil blowing, flooding.	Wetness, soil blowing.	Wetness, excess salt.
19. Gracemore	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Wetness, flooding, excess salt.	Wetness	Wetness, excess salt.
20. Grandfield	Moderate: seepage.	Severe: piping.	Severe: no water.	Fast intake, soil blowing.	Soil blowing	Favorable.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Irrigation	Terraces and diversions	Grassed waterways
21 Grandfield	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Fast intake, soil blowing, slope.	Soil blowing	Favorable.
22 Grandfield	Moderate: seepage.	Severe: piping.	Severe: no water.	Soil blowing	Soil blowing	Favorable.
23 Grandfield	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Soil blowing, slope.	Soil blowing	Favorable.
24 Grandmore	Slight	Severe: piping.	Severe: no water.	Fast intake, soil blowing.	Soil blowing	Percs slowly.
25 Hardeman	Severe: seepage.	Severe: piping.	Severe: no water.	Soil blowing	Soil blowing	Favorable.
26, 27 Hardeman	Severe: seepage.	Severe: piping.	Severe: no water.	Soil blowing, slope.	Soil blowing	Favorable.
28, 29 Hardeman	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Soil blowing, slope.	Slope, soil blowing.	Slope.
30*:						
Hardeman	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Soil blowing, slope.	Slope, soil blowing.	Slope.
Likes	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Droughty, fast intake, soil blowing.	Too sandy, soil blowing, slope.	Droughty, slope.
Devol	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Soil blowing, slope.	Slope, too sandy, soil blowing.	Slope.
31 Hollister	Slight	Severe: hard to pack.	Severe: no water.	Percs slowly	Percs slowly	Percs slowly.
32*:						
Knoco	Severe: slope, depth to rock.	Severe: thin layer.	Severe: no water.	Droughty, erodes easily, slow intake, percs slowly, depth to rock, slope.	Slope, erodes easily, percs slowly, depth to rock.	Slope, erodes easily, droughty, depth to rock, percs slowly.
Aspermont	Severe: slope.	Moderate: piping.	Severe: no water.	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
33*:						
Knoco	Severe: depth to rock, slope.	Severe: thin layer.	Severe: no water.	Droughty, slow intake, percs slowly, slope, depth to rock, erodes easily.	Erodes easily, percs slowly, slope, depth to rock.	Erodes easily, droughty, slope, depth to rock, percs slowly.
Badland.						
34*:						
Knoco	Severe: slope, depth to rock.	Severe: thin layer.	Severe: no water.	Droughty, erodes easily, slow intake, percs slowly, slope, depth to rock.	Slope, erodes easily, percs slowly, depth to rock.	Slope, erodes easily, droughty, percs slowly, depth to rock.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Irrigation	Terraces and diversions	Grassed waterways
34*: Cornick	Severe: depth to rock, slope, seepage.	Severe: thin layer.	Severe: no water.	Depth to rock, slope, erodes easily.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Rock outcrop.						
35*: Knoco	Severe: slope, depth to rock.	Severe: thin layer.	Severe: no water.	Droughty, slow intake, percs slowly, slope, depth to rock, erodes easily.	Slope, erodes easily, percs slowly, depth to rock.	Slope, erodes easily, droughty, percs slowly, depth to rock.
Rock outcrop.						
36 Likes	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
37 Lincoln	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
38, 39 Madge	Moderate: seepage.	Moderate: piping.	Severe: no water.	Erodes easily	Erodes easily	Erodes easily.
40 Mangum	Slight	Moderate: hard to pack.	Severe: no water.	Percs slowly, flooding, slow intake.	Percs slowly	Percs slowly.
41 Mangum	Slight	Moderate: hard to pack.	Severe: no water.	Slow intake, percs slowly, erodes easily.	Percs slowly, erodes easily.	Percs slowly, erodes easily.
42 McKnight	Moderate: depth to rock.	Severe: piping.	Severe: no water.	Fast intake, soil blowing, percs slowly.	Soil blowing, percs slowly.	Percs slowly.
43 McKnight	Moderate: depth to rock, slope.	Severe: piping.	Severe: no water.	Fast intake, soil blowing, percs slowly.	Soil blowing, percs slowly.	Percs slowly.
44 McKnight	Moderate: depth to rock.	Severe: piping.	Severe: no water.	Soil blowing, percs slowly.	Soil blowing, percs slowly.	Percs slowly.
45 Nobscot	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
46 Nobscot	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
47*: Quanah	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Slope, erodes easily.	Erodes easily	Erodes easily.
Talpa	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Depth to rock, slope.	Depth to rock	Depth to rock.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Irrigation	Terraces and diversions	Grassed waterways
48*: Quinlan	Severe: depth to rock, slope.	Severe: piping, thin layer.	Severe: no water.	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Rock outcrop.						
49*: Quinlan	Severe: depth to rock.	Severe: piping, thin layer.	Severe: no water.	Depth to rock, slope.	Depth to rock	Depth to rock.
Woodward	Moderate: depth to rock, seepage, slope.	Severe: piping.	Severe: no water.	Slope, erodes easily, depth to rock.	Depth to rock, erodes easily.	Depth to rock, erodes easily.
50. Salt flats						
51 Shrewder	Severe: seepage.	Severe: piping.	Severe: no water.	Soil blowing	Soil blowing	Soil blowing.
52 Shrewder	Severe: seepage.	Severe: piping.	Severe: no water.	Soil blowing, slope.	Soil blowing	Soil blowing.
53, 54 Spur	Moderate: seepage.	Severe: piping.	Severe: no water.	Flooding	Favorable	Favorable.
55, 56 Tillman	Slight	Moderate: hard to pack.	Severe: no water.	Percs slowly, erodes easily.	Percs slowly, erodes easily.	Percs slowly, erodes easily.
57, 58 Tipton	Moderate: seepage.	Moderate: piping.	Severe: no water.	Erodes easily	Erodes easily	Erodes easily.
59 Tivoli	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Droughty, fast intake, soil blowing, slope.	Slope, too sandy, soil blowing.	Slope, droughty.
60*: Likes	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Droughty, fast intake, soil blowing.	Too sandy, soil blowing, slope.	Droughty, slope.
Devol	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Soil blowing, slope, fast intake.	Slope, too sandy, soil blowing.	Slope.
61. Ustorthents						
62 Vernon	Moderate: depth to rock.	Moderate: hard to pack, thin layer.	Severe: no water.	Depth to rock, percs slowly, erodes easily.	Erodes easily, percs slowly, depth to rock.	Depth to rock, percs slowly, erodes easily.
63, 64 Vernon	Moderate: depth to rock, slope.	Moderate: hard to pack, thin layer.	Severe: no water.	Erodes easily, percs slowly, slope, depth to rock.	Erodes easily, percs slowly, depth to rock.	Depth to rock, erodes easily, percs slowly.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Irrigation	Terraces and diversions	Grassed waterways
65*:						
Vernon-----------	Severe: slope.	Moderate: hard to pack, thin layer.	Severe: no water.	Erodes easily, percs slowly, slope, depth to rock.	Slope, erodes easily, percs slowly, depth to rock.	Slope, erodes easily, depth to rock, percs slowly.
Knoco------------	Severe: slope, depth to rock.	Severe: thin layer.	Severe: no water.	Erodes easily, droughty, slow intake, percs slowly, depth to rock, slope.	Slope, erodes easily, percs slowly, depth to rock.	Slope, erodes easily, droughty, percs slowly, depth to rock.
66---------------- Westview	Slight---------	Moderate: piping.	Severe: no water.	Favorable------	Favorable------	Favorable.
67---------------- Woodward	Moderate: depth to rock, seepage.	Severe: piping.	Severe: no water.	Erodes easily, depth to rock.	Depth to rock, erodes easily.	Depth to rock, erodes easily.
68---------------- Woodward	Moderate: depth to rock, seepage, slope.	Severe: piping.	Severe: no water.	Slope, erodes easily, depth to rock.	Depth to rock, erodes easily.	Depth to rock, erodes easily.
69*:						
Woodward---------	Moderate: depth to rock, seepage.	Severe: piping.	Severe: no water.	Erodes easily, depth to rock.	Depth to rock, erodes easily.	Depth to rock, erodes easily.
Quinlan----------	Severe: depth to rock.	Severe: piping, thin layer.	Severe: no water.	Depth to rock	Depth to rock	Depth to rock.
70*:						
Woodward---------	Moderate: depth to rock, seepage, slope.	Severe: piping.	Severe: no water.	Slope, erodes easily, depth to rock.	Depth to rock, erodes easily.	Depth to rock, erodes easily.
Quinlan----------	Severe: depth to rock.	Severe: piping, thin layer.	Severe: no water.	Depth to rock, slope.	Depth to rock	Depth to rock.
71*:						
Woodward---------	Severe: slope.	Severe: piping.	Severe: no water.	Slope, erodes easily, depth to rock.	Depth to rock, erodes easily, slope.	Slope, depth to rock, erodes easily.
Quinlan----------	Severe: depth to rock, slope.	Severe: piping, thin layer.	Severe: no water.	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
72---------------- Yahola	Severe: seepage.	Severe: piping.	Severe: no water.	Soil blowing---	Soil blowing---	Favorable.
73---------------- Yahola	Severe: seepage.	Severe: piping.	Severe: no water.	Soil blowing---	Soil blowing---	Favorable.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
1----------------- Abilene	0-11	Loam--------------	CL	A-4, A-6	0	100	100	96-100	65-85	24-37	4-14
	11-38	Clay loam, silty clay loam, clay.	CL, CH	A-7, A-6	0	95-100	95-100	90-100	75-95	34-58	22-40
	38-80	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	90-100	88-100	80-98	60-95	35-50	19-32
2----------------- Abilene	0-16	Loam--------------	CL	A-4, A-6	0	100	100	96-100	65-85	24-37	4-14
	16-45	Clay loam, silty clay loam, clay.	CL, CH	A-7, A-6	0	95-100	95-100	90-100	75-95	34-58	22-40
	45-80	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	90-100	88-100	80-98	60-95	35-50	19-32
3*:											
Acme-------------	0-14	Silt loam---------	CL	A-4, A-6	0	100	100	96-100	80-97	30-37	8-13
	14-36	Gypsiferous material.	---	---	---	---	---	---	---	---	---
Vinson-----------	0-17	Silt loam---------	CL	A-4, A-6	0	100	100	96-100	80-97	30-37	8-13
	17-28	Silt loam, silty clay loam.	CL	A-4, A-6, A-7	0	100	100	96-100	80-98	30-42	8-19
	28-80	Gypsiferous material.	---	---	---	---	---	---	---	---	---
4*:											
Acme-------------	0-13	Silt loam---------	CL	A-4, A-6	0	100	100	96-100	80-97	30-37	8-13
	13-80	Gypsiferous material.	---	---	---	---	---	---	---	---	---
Vinson-----------	0-12	Silt loam---------	CL	A-4, A-6	0	100	100	96-100	80-97	30-37	8-13
	12-30	Silt loam, silty clay loam.	CL	A-4, A-6, A-7	0	100	100	96-100	80-98	30-42	8-19
	30-80	Gypsiferous material.	---	---	---	---	---	---	---	---	---
5----------------- Altus	0-12	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	12-21	Fine sandy loam	SM, ML, SC, CL	A-4	0	100	98-100	94-100	36-60	<30	NP-10
	21-70	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
6----------------- Altus	0-13	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	13-19	Fine sandy loam	SM, ML, SC, CL	A-4	0	100	98-100	94-100	36-60	<30	NP-10
	19-38	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	38-70	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4	0	100	98-100	90-100	36-60	<30	NP-10
7----------------- Aspermont	0-14	Silt loam---------	CL	A-4, A-6 A-7-6	0	100	100	96-100	80-97	30-37	8-13
	14-41	Silt loam, clay, loam, silty clay loam.	CL	A-6, A-7-6	0	98-100	90-100	90-100	51-95	30-45	15-28
	41-80	Weathered bedrock	---	---	---	---	---	---	---	---	---
8----------------- Aspermont	0-13	Silt loam---------	CL	A-4, A-6	0	100	100	96-100	80-97	30-37	8-13
	13-58	Silt loam, clay loam, silty clay loam.	CL	A-6, A-7-6	0	98-100	90-100	90-100	51-95	30-45	15-28
	58-80	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
9---------------- Aspermont	0-7	Silt loam--------	CL	A-4, A-6	0	100	100	96-100	80-97	30-37	8-13
	7-60	Silt loam, clay loam, silty clay loam.	CL	A-6, A-7-6	0	98-100	90-100	90-100	51-95	30-45	15-28
10---------------- Beckman	0-11	Silty clay-------	CH, CL	A-7	0	100	100	96-100	90-95	45-60	19-34
	11-80	Clay-------------	CL, CH	A-7	0	95-100	95-100	95-100	90-95	45-60	19-34
11---------------- Carey	0-15	Loam-------------	CL, ML, CL-ML	A-4, A-6	0	100	98-100	90-100	51-95	20-32	3-15
	15-65	Silty clay loam, clay loam, loam.	CL, CL-ML	A-4, A-6	0	100	98-100	95-100	60-95	24-40	5-20
	65-80	Weathered bedrock	---	---	---	---	---	---	---	---	---
12---------------- Clairemont	0-80	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	98-100	95-100	51-95	25-40	7-20
13*: Cornick----------	0-5	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0	100	100	90-100	70-90	22-37	2-14
	5-10	Weathered bedrock	---	---	---	---	---	---	---	---	---
	10-15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Vinson----------	0-18	Silt loam--------	CL	A-4, A-6	0	100	100	96-100	65-97	30-37	8-14
	18-25	Silt loam, loam, clay loam.	CL	A-4, A-6, A-7	0	100	100	96-100	65-98	30-43	8-20
	25-30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
14---------------- Devol	0-12	Loamy fine sand	SM	A-2	0	98-100	98-100	90-100	15-35	---	NP
	12-35	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4, A-2	0	98-100	98-100	94-100	30-60	<26	NP-7
	35-44	Loamy fine sand, fine sandy loam.	SM, ML, SM-SC, CL-ML	A-2, A-4	0	98-100	98-100	90-100	15-60	<26	NP-7
	44-80	Loamy fine sand, loamy sand, fine sand.	SM	A-2, A-4	0	98-100	98-100	50-100	15-50	<26	NP-3
15---------------- Devol	0-15	Loamy fine sand	SM	A-2	0	98-100	98-100	90-100	15-35	---	NP
	15-48	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4, A-2	0	98-100	98-100	94-100	30-60	<26	NP-7
	48-62	Loamy fine sand, fine sandy loam.	SM, ML, SM-SC, CL-ML	A-2, A-4	0	98-100	98-100	90-100	15-60	<26	NP-7
	62-80	Loamy fine sand, loamy sand, fine sand.	SM	A-2, A-4	0	98-100	98-100	50-100	15-50	<26	NP-3
16---------------- Devol	0-6	Loamy fine sand	SM	A-2	0	98-100	98-100	90-100	15-35	---	NP
	6-25	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4, A-2	0	98-100	98-100	94-100	30-60	<26	NP-7
	25-42	Loamy fine sand, fine sandy loam.	SM, ML, SM-SC, CL-ML	A-2, A-4	0	98-100	98-100	90-100	15-60	<26	NP-7
	42-80	Loamy fine sand, loamy sand, fine sand.	SM	A-2, A-4	0	98-100	98-100	50-100	15-50	<26	NP-3

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
17----------------- Devol	0-9	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4, A-2	0	98-100	98-100	94-100	30-60	<26	NP-7
	9-34	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4, A-2	0	98-100	98-100	94-100	30-60	<26	NP-7
	34-44	Loamy fine sand, fine sandy loam.	SM, ML, SM-SC, CL-ML	A-2, A-4	0	98-100	98-100	90-100	15-60	<26	NP-7
	44-80	Loamy fine sand, loamy sand, fine sand.	SM	A-2, A-4	0	98-100	98-100	50-100	15-50	<26	NP-3
18----------------- Gracemont	0-14	Fine sandy loam	ML, CL-ML, SM, SM-SC	A-4	0	100	98-100	94-100	36-90	<26	NP-7
	14-80	Fine sandy loam, loam.	ML, CL-ML, SM, SM-SC	A-4	0	100	98-100	94-100	36-90	22-29	2-7
19----------------- Gracemore	0-12	Loam---------------	ML, CL, CL-ML	A-4, A-6	0	90-100	85-100	85-100	51-97	22-40	2-18
	12-80	Stratified fine sand to clay loam.	SM, SP-SM	A-2, A-3	0	90-100	85-100	82-100	5-35	---	NP
20----------------- Grandfield	0-15	Loamy fine sand	SM	A-2	0	100	98-100	90-100	15-35	---	NP
	15-38	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	38-68	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	68-80	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4	0	100	98-100	90-100	36-60	<30	NP-10
21----------------- Grandfield	0-11	Loamy fine sand	SM	A-2	0	100	98-100	90-100	15-35	---	NP
	11-20	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	20-44	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	44-80	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4	0	100	98-100	90-100	36-60	<30	NP-10
22----------------- Grandfield	0-9	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	9-14	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	14-38	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	38-80	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4	0	100	98-100	90-100	36-60	<30	NP-10
23----------------- Grandfield	0-7	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	7-14	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	14-41	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	41-80	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4	0	100	98-100	90-100	36-60	<30	NP-10
24----------------- Grandmore	0-18	Loamy fine sand	SM	A-2	0	100	98-100	90-100	15-35	---	NP
	18-31	Sandy clay loam, fine sandy loam.	CL, ML, SM, SC	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	31-80	Clay loam, clay	CL, CH	A-6, A-7	0	100	100	96-100	80-95	31-60	10-34

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
25, 26----------- Hardeman	0-9	Fine sandy loam	SM, SM-SC, CL-ML, ML	A-4,	0	100	98-100	94-100	36-60	<26	NP-7
	9-80	Fine sandy loam, loam.	ML, SM, CL-ML, SM-SC	A-4, A-2-4	0	100	98-100	70-95	30-70	18-25	2-7
27--------------- Hardeman	0-11	Fine sandy loam	SM, SM-SC, CL-ML, ML	A-4,	0	100	98-100	94-100	36-60	<26	NP-7
	11-80	Fine sandy loam, loam.	ML, SM, CL-ML, SM-SC	A-4, A-2-4	0	100	98-100	70-95	30-70	18-25	2-7
28--------------- Hardeman	0-5	Fine sandy loam	SM, SM-SC, CL-ML, ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	5-80	Fine sandy loam, loam.	ML, SM, CL-ML, SM-SC	A-4, A-2-4	0	100	98-100	70-95	30-70	18-25	2-7
29--------------- Hardeman	0-14	Fine sandy loam	SM, SM-SC, CL-ML, ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	14-56	Fine sandy loam, loam.	ML, SM, CL-ML, SM-SC	A-4, A-2-4	0	100	98-100	70-95	30-70	18-25	2-7
	56-80	Fine sandy loam, loamy fine sand.	SM, SM-SC, CL-ML, ML	A-2, A-4	0	100	98-100	90-100	15-60	<26	NP-7
30*:											
Hardeman---------	0-10	Fine sandy loam	SM, SM-SC, CL-ML, ML	A-4,	0	100	98-100	94-100	36-60	<26	NP-7
	10-80	Fine sandy loam, loam.	ML, SM, CL-ML, SM-SC	A-4, A-2-4	0	100	98-100	70-95	30-70	18-25	2-7
Likes------------	0-11	Gravelly loamy fine sand.	SM, SP-SM	A-1, A-2	0	60-80	50-75	25-50	7-25	---	NP
	11-80	Gravelly fine sand, gravelly sand.	SM, SP, SP-SM	A-1, A-2, A-3	0-1	65-80	55-75	15-60	2-25	---	NP
Devol------------	0-8	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4, A-2	0	98-100	98-100	94-100	30-60	<26	NP-7
	8-24	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4, A-2	0	98-100	98-100	94-100	30-60	<26	NP-7
	24-38	Loamy fine sand, fine sandy loam.	SM, ML, SM-SC, CL-ML	A-2, A-4	0	98-100	98-100	90-100	15-60	<26	NP-7
	38-80	Loamy fine sand, loamy sand, fine sand.	SM	A-2, A-4	0	98-100	98-100	50-100	15-50	<26	NP-3
31--------------- Hollister	0-21	Silty clay loam	CL	A-6, A-7	0	100	100	98-100	90-98	33-42	12-19
	21-70	Clay, silty clay loam, clay loam.	CL, CH	A-6, A-7-6	0	98-100	95-100	95-100	75-98	38-70	20-45
	70-80	Clay, silty clay loam, clay loam.	CL, CH	A-6, A-7-6	0	98-100	95-100	85-99	70-98	35-60	18-40
32*:											
Knoco------------	0-8	Silty clay--------	CL, CH	A-7-6, A-6	0-5	90-100	90-100	90-100	80-98	32-60	14-38
	8-40	Weathered bedrock, shaly clay, clay.	CL, CH	A-7-6, A-6	0-5	90-100	85-100	60-100	60-95	30-60	13-38
Aspermont--------	0-6	Silt loam--------	CL	A-4, A-6 A-7-6	0	100	100	96-100	80-97	30-37	8-13
	6-80	Silt loam, clay loam, silty clay loam.	CL	A-6, A-7-6	0	98-100	90-100	85-100	51-95	30-45	15-28

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
33*:											
Knoco	0-9	Clay	CL, CH	A-7-6, A-6	0-5	90-100	90-100	90-100	80-98	32-60	14-38
	9-40	Weathered bedrock, shaly clay, clay.	CL, CH	A-7-6, A-6	0-5	90-100	85-100	60-100	60-95	30-60	13-38
Badland.											
34*:											
Knoco	0-10	Clay	CL, CH	A-7-6, A-6	0-5	90-100	90-100	90-100	80-98	32-60	14-38
	10-30	Weathered bedrock, shaly clay, clay.	CL, CH	A-7-6, A-6	0-5	90-100	85-100	60-100	60-95	30-60	13-38
Cornick	0-9	Silt loam	CL, ML, CL-ML	A-4, A-6	0	100	100	90-100	70-90	22-37	2-14
	9-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
35*:											
Knoco	0-6	Clay	CL, CH	A-7-6, A-6	0-5	90-100	90-100	90-100	80-98	32-60	14-38
	6-20	Weathered bedrock, shaly clay, clay.	CL, CH	A-7-6, A-6	0-5	90-100	85-100	60-100	60-95	30-60	13-38
Rock outcrop.											
36 Likes	0-6	Fine sand	SM, SP-SM	A-2, A-3	0	100	98-100	82-98	5-25	---	NP
	6-80	Fine sand, sand	SM, SP-SM	A-2, A-3	0	100	98-100	82-98	5-25	---	NP
37 Lincoln	0-9	Loamy fine sand	SM	A-2	0	100	98-100	90-100	15-35	---	NP
	9-80	Stratified fine sand to clay loam.	SM, SP-SM	A-2, A-3	0	100	98-100	82-100	5-35	---	NP
38 Madge	0-14	Loam	ML, CL, CL-ML	A-4	0	100	100	96-100	65-85	22-32	2-10
	14-43	Loam, clay loam, sandy clay loam.	CL, SC	A-4, A-6	0	100	100	90-100	40-90	25-40	7-18
	43-80	Loam, fine sandy loam.	ML, CL, SM, SC	A-4	0	100	98-100	94-100	36-85	<30	NP-10
39 Madge	0-13	Loam	ML, CL, CL-ML	A-4	0	100	100	96-100	65-85	22-32	2-10
	13-41	Loam, clay loam, sandy clay loam.	CL, SC	A-4, A-6	0	100	100	90-100	40-90	25-40	7-18
	41-57	Loam, fine sandy loam.	ML, CL, SM, SC	A-4	0	100	98-100	94-100	36-85	<30	NP-10
	57-80	Loam, fine sandy loam, very fine sandy loam.	ML, CL, SM, SC	A-4	0	100	98-100	94-100	36-85	<30	NP-10
40 Mangum	0-7	Silty clay loam	CL	A-6, A-7	0	100	98-100	90-98	53-42	53-42	12-19
	7-21	Clay, silty clay	CL, CH	A-7	0	100	100	96-100	90-100	41-70	18-45
	21-65	Clay loam, silty clay, silty clay loam.	CL, CH	A-6, A-7	0	100	100	96-100	80-99	33-60	13-34
41 Mangum	0-11	Silty clay	CL, CH	A-7	0	100	100	98-100	93-99	41-60	18-34
	11-57	Clay, silty clay	CL, CH	A-7	0	100	100	95-100	90-100	41-70	18-45
	57-80	Clay loam, silty clay, silty clay loam.	CL, CH	A-6, A-7	0	100	100	96-100	80-99	33-60	13-34

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
42---------------- McKnight	0-8	Loamy fine sand	SM	A-2	0	100	98-100	90-100	15-35	---	NP
	8-33	Sandy clay loam, fine sandy loam.	CL, SC, ML CL-ML, SM-SC	A-4, A-6	0	100	98-100	90-100	36-65	20-37	8-16
	33-45	Clay, clay loam, silty clay loam.	CL, CH	A-6, A-7	0-5	95-100	85-100	80-100	75-98	37-60	15-34
	45-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
43---------------- McKnight	0-7	Loamy fine sand	SM	A-2	0	100	98-100	90-100	15-35	---	NP
	7-35	Sandy clay loam, fine sandy loam.	CL, SC, ML CL-ML, SM-SC	A-4, A-6	0	100	98-100	90-100	36-65	20-37	8-16
	35-50	Clay, clay loam, silty clay loam.	CL, CH	A-6, A-7	0-5	95-100	85-100	80-100	75-98	37-60	15-34
	50-80	Weathered bedrock	---	---	---	---	---	---	---	---	---
44---------------- McKnight	0-7	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	7-35	Sandy clay loam, fine sandy loam.	CL, SC, ML CL-ML, SM-SC	A-4, A-6	0	100	98-100	90-100	36-65	20-37	8-16
	35-50	Clay, clay loam, silty clay loam.	CL, CH	A-6, A-7	0-5	95-100	85-100	80-100	75-98	37-60	15-34
	50-80	Weathered bedrock	---	---	---	---	---	---	---	---	---
45---------------- Nobscot	0-27	Fine sand--------	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
	27-40	Sandy loam, fine sandy loam.	SM, ML, SM-SC, CL-ML	A-4	0	100	95-100	90-100	36-60	<26	NP-7
	40-72	Fine sand, loamy sand, loamy fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
	72-80	Fine sand, loamy sand, loamy fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
46---------------- Nobscot	0-39	Fine sand--------	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
	39-50	Sandy loam, fine sandy loam.	SM, ML, SM-SC, CL-ML	A-4	0	100	95-100	90-100	36-60	<26	NP-7
	50-85	Fine sand, loamy sand, loamy fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
47*:											
Quanah----------	0-14	Silty clay loam	CL	A-6, A-7	0	100	100	98-100	90-98	33-42	12-19
	14-36	Silty clay loam, clay loam, loam.	CL	A-4, A-6	0	96-100	96-100	85-100	55-95	25-40	8-20
	36-80	Silty clay loam, clay loam, loam.	CL	A-4, A-6	0	90-100	85-100	85-98	55-95	25-40	8-20
Talpa-----------	0-11	Loam------------	CL	A-4, A-6, A-7	0-10	65-90	60-85	55-85	51-80	25-45	8-25
	11-15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
48*:											
Quinlan---------	0-10	Very fine sandy loam, loam.	CL, ML, CL-ML	A-4, A-6	0	100	95-100	90-100	51-97	<37	NP-14
	10-40	Weathered bedrock	---	---	---	---	---	---	---	---	---
Rock outcrop.											

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
49*:											
Quinlan----------	0-17	Loam, very fine sandy loam.	CL, ML, CL-ML	A-4, A-6	0	100	95-100	90-100	51-97	<37	NP-14
	17-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Woodward---------	0-29	Loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	51-95	<31	NP-12
	29-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
50. Salt flats											
51--------------- Shrewder	0-16	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	16-49	Loam, very fine sandy loam, fine sandy loam.	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-85	<29	NP-7
	49-77	Loam, fine sandy loam, loamy fine sand.	SM, ML, SM-SC, CL-ML	A-2, A-4	0	100	98-100	90-100	15-85	<29	NP-7
	77-80	Weathered bedrock	---	---	---	---	---	---	---	---	---
52--------------- Shrewder	0-11	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	11-49	Loam, very fine sandy loam, fine sandy loam.	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-85	<29	NP-7
	49-62	Loam, fine sandy loam, loamy fine sand.	SM, ML, SM-SC, CL-ML	A-2, A-4	0	100	98-100	90-100	15-85	<29	NP-7
	62-80	Weathered bedrock	---	---	---	---	---	---	---	---	---
53--------------- Spur	0-11	Clay loam--------	CL	A-4, A-6, A-7-6	0	100	100	96-100	75-90	31-40	10-18
	11-80	Loam, clay loam, sandy clay loam.	CL, SC, SM-SC, CL-ML	A-4, A-6, A-7-6	0	100	100	100	45-95	22-45	7-25
54--------------- Spur	0-18	Clay loam--------	CL	A-4, A-6, A-7-6	0	100	100	96-100	75-90	31-40	10-18
	18-80	Loam, clay loam, sandy clay loam.	CL, SC, SM-SC, CL-ML	A-4, A-6, A-7-6	0	100	95-100	90-100	45-95	22-45	7-25
55--------------- Tillman	0-12	Clay loam--------	CL	A-6, A-7 A-7-6	0	100	100	96-100	80-90	34-43	13-20
	12-60	Clay, clay loam	CL, CH	A-6, A-7-6	0	95-100	90-100	90-98	70-98	38-60	20-38
	60-80	Clay, clay loam	CL, CH	A-6, A-7-6	0-5	90-100	85-100	65-97	60-95	30-60	15-38
56--------------- Tillman	0-12	Clay loam--------	CL	A-6, A-7	0	100	100	96-100	80-90	34-43	13-20
	12-51	Clay, clay loam	CL, CH	A-6, A-7-6	0	95-100	90-100	90-98	70-98	38-60	20-38
	51-80	Clay, clay loam	CL, CH	A-6, A-7-6	0-5	90-100	85-100	65-97	60-95	30-60	15-38
57--------------- Tipton	0-9	Loam-------------	ML, CL-ML	A-4	0	100	100	96-100	65-85	22-29	2-7
	9-80	Clay loam, loam	CL	A-4, A-6	0	100	100	95-100	65-90	30-40	9-18
58--------------- Tipton	0-8	Loam-------------	ML, CL-ML	A-4	0	100	100	96-100	65-85	22-29	2-7
	8-80	Clay loam, loam	CL	A-4, A-6	0	100	100	95-100	65-90	30-40	9-18

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
59--------------- Tivoli	0-13	Fine sand--------	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-25	---	NP
	13-80	Fine sand, sand	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-25	---	NP
60*:											
Likes-----------	0-11	Gravelly loamy fine sand.	SM, SP-SM	A-2	0	60-80	50-75	25-50	7-25	---	NP
	11-80	Gravelly fine sand, gravelly loamy fine sand.	SM, SP, SP-SM	A-2, A-3	0-10	65-80	55-75	15-60	2-25	---	NP
Devol-----------	0-6	Loamy fine sand	SM	A-2	0	98-100	98-100	90-100	15-35	---	NP
	6-24	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4, A-2	0	98-100	98-100	94-100	30-60	<26	NP-7
	24-36	Loamy fine sand, fine sandy loam.	SM, ML, SM-SC, CL-ML	A-2, A-4	0	98-100	98-100	90-100	15-60	<26	NP-7
	36-80	Loamy fine sand, loamy sand, fine sand.	SM	A-2, A-4	0	98-100	98-100	50-100	15-50	<26	NP-3
61. Ustorthents											
62--------------- Vernon	0-7	Clay loam--------	CL	A-6, A-7 A-7-6	0	100	100	96-100	80-90	37-50	16-26
	7-34	Clay, silty clay	CL, CH	A-6, A-7-6	0	95-100	90-100	90-100	80-98	38-60	20-38
	34-60	Weathered bedrock shaly clay, clay	CL, CH	A-6, A-7-6	0-5	90-100	85-100	65-100	65-96	30-60	15-38
63--------------- Vernon	0-7	Clay loam--------	CL	A-6, A-7 A-7-6	0	100	100	96-100	80-90	37-50	16-26
	7-38	Clay, silty clay	CL, CH	A-6, A-7-6	0	95-100	90-100	90-100	80-98	38-60	20-38
	38-80	Weathered bedrock shaly clay, clay	CL, CH	A-6, A-7-6	0-5	90-100	85-100	65-100	65-96	30-60	15-38
64--------------- Vernon	0-8	Clay loam--------	CL	A-6, A-7 A-7-6	0	100	100	96-100	80-90	37-50	16-26
	8-21	Clay, silty clay	CL, CH	A-6, A-7-6	0	95-100	90-100	90-100	80-98	38-60	20-38
	21-80	Weathered bedrock shaly clay, clay	CL, CH	A-6, A-7-6	0-5	90-100	85-100	65-100	65-96	30-60	15-38
65*:											
Vernon----------	0-4	Clay loam--------	CL	A-6, A-7 A-7-6	0	100	100	96-100	80-90	37-50	16-26
	4-24	Clay, silty clay	CL, CH	A-6, A-7-6	0	95-100	90-100	90-100	80-98	38-60	20-38
	24-80	Weathered bedrock shaly clay, clay	CL, CH	A-6, A-7-6	0-5	90-100	85-100	65-100	65-96	30-60	15-38
Knoco-----------	0-8	Clay-------------	CL, CH	A-7-6, A-6	0-5	90-100	90-100	90-100	80-98	32-60	14-38
	8-80	Weathered bedrock, shaly clay, clay.	CL, CH	A-7-6, A-6	0-5	90-100	85-100	60-100	60-95	30-60	13-38
66--------------- Westview	0-6	Silty clay loam	CL	A-6, A-7	0	100	100	98-100	90-98	33-42	12-19
	6-36	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	96-100	80-98	33-43	12-20
	36-80	Silt loam, loam, silty clay loam.	CL	A-4, A-6, A-7	0	100	100	96-100	65-98	30-43	8-20

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
67---------------- Woodward	0-38	Loam--------------	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	51-95	<31	NP-12
	38-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
68---------------- Woodward	0-28	Loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	51-95	<31	NP-12
	28-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
69*: Woodward---------	0-35	Loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	51-95	<31	NP-12
	35-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Quinlan----------	0-14	Loam, very fine sandy loam.	CL, ML, CL-ML	A-4, A-6	0	100	95-100	90-100	51-97	<37	NP-14
	14-40	Weathered bedrock	---	---	---	---	---	---	---	---	---
70*: Woodward---------	0-25	Loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	51-95	<31	NP-12
	25-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Quinlan----------	0-13	Loam, very fine sandy loam.	CL, ML, CL-ML	A-4, A-6	0	100	95-100	90-100	51-97	<37	NP-14
	13-40	Weathered bedrock	---	---	---	---	---	---	---	---	---
71*: Woodward---------	0-26	Loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	51-95	<31	NP-12
	26-40	Weathered bedrock	---	---	---	---	---	---	---	---	---
Quinlan----------	0-12	Loam, very fine sandy loam.	CL, ML, CL-ML	A-4, A-6	0	100	95-100	90-100	51-97	<37	NP-14
	12-20	Weathered bedrock	---	---	---	---	---	---	---	---	---
72---------------- Yahola	0-12	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	12-80	Fine sandy loam, loam, very fine sandy loam.	SM, ML, CL-ML, SM-SC	A-4	0	100	95-100	90-100	36-85	<26	NP-7
73---------------- Yahola	0-5	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	5-80	Fine sandy loam, loam, very fine sandy loam.	SM, ML, CL-ML, SM-SC	A-4	0	100	95-100	90-100	36-85	<26	NP-7

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm³	In/hr	In/in	pH	Mmhos/cm					Pct
1----------------- Abilene	0-11	15-27	1.30-1.65	0.6-2.0	0.15-0.20	6.6-8.4	<2	Moderate	0.37	5	6	1-3
	11-38	35-50	1.30-1.70	0.2-0.6	0.14-0.18	6.6-8.4	<2	Moderate	0.28			
	38-80	22-45	1.30-1.70	0.2-0.6	0.12-0.15	7.9-8.4	<2	Moderate	0.32			
2----------------- Abilene	0-16	15-27	1.30-1.65	0.6-2.0	0.15-0.20	6.6-8.4	<2	Moderate	0.37	5	6	1-3
	16-45	35-50	1.30-1.70	0.2-0.6	0.14-0.18	6.6-8.4	<2	Moderate	0.28			
	45-80	22-45	1.30-1.70	0.2-0.6	0.12-0.15	7.9-8.4	<2	Moderate	0.32			
3*:												
Acme-------------	0-14	15-25	1.30-1.50	0.6-2.0	0.16-0.24	7.4-8.4	<2	Low--------	0.37	1	4L	1-3
	14-80	---	---	2.0-6.0	---	---	---	-----------	----			
Vinson-----------	0-17	15-27	1.30-1.50	0.6-2.0	0.16-0.24	7.4-8.4	<2	Low--------	0.37	2	4L	1-2
	17-28	18-30	1.40-1.70	0.6-2.0	0.16-0.24	7.4-8.4	<2	Moderate	0.37			
	28-80	---	---	2.0-6.0	---	---	---	-----------	----			
4*:												
Acme-------------	0-13	15-25	1.30-1.50	0.6-2.0	0.16-0.24	7.4-8.4	<2	Low--------	0.37	1	4L	1-3
	13-80	---	---	2.0-6.0	---	---	---	-----------	----			
Vinson-----------	0-12	15-27	1.30-1.50	0.6-2.0	0.16-0.24	7.4-8.4	<2	Low--------	0.37	2	4L	1-2
	12-30	18-30	1.40-1.70	0.6-2.0	0.16-0.24	7.4-8.4	<2	Moderate	0.37			
	30-80	---	---	2.0-6.0	---	---	---	-----------	----			
5----------------- Altus	0-12	10-18	1.30-1.60	2.0-6.0	0.11-0.15	6.1-7.3	<2	Low--------	0.24	5	3	1-2
	12-21	12-19	1.50-1.70	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low--------	0.24			
	21-70	18-28	1.50-1.65	0.6-2.0	0.11-0.17	6.6-8.4	<2	Low--------	0.32			
6----------------- Altus	0-13	10-18	1.30-1.60	2.0-6.0	0.11-0.15	6.1-7.3	<2	Low--------	0.24	5	3	1-2
	13-19	12-19	1.50-1.70	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low--------	0.24			
	19-38	18-28	1.50-1.65	0.6-2.0	0.11-0.17	6.6-8.4	<2	Low--------	0.32			
	38-70	15-25	1.50-1.65	2.0-6.0	0.11-0.15	6.6-8.4	<2	Low--------	0.32			
7----------------- Aspermont	0-14	18-27	1.30-1.50	0.6-2.0	0.16-0.24	7.9-8.4	<2	Low--------	0.37	4	4L	.5-2
	14-41	20-35	1.45-1.70	0.6-2.0	0.12-0.18	7.9-8.4	<2	Moderate	0.32			
	41-80	---	---	---	---	---	---	-----------	----			
8----------------- Aspermont	0-13	18-27	1.30-1.50	0.6-2.0	0.16-0.24	7.9-8.4	<2	Low--------	0.37	4	4L	.5-2
	13-58	20-35	1.45-1.70	0.6-2.0	0.12-0.18	7.9-8.4	<2	Moderate	0.32			
	58-80	---	---	---	---	---	---	-----------	----			
9----------------- Aspermont	0-7	18-27	1.30-1.50	0.6-2.0	0.16-0.24	7.9-8.4	<2	Low--------	0.37	4	4L	.5-2
	7-40	20-35	1.45-1.70	0.6-2.0	0.12-0.18	7.9-8.4	<2	Moderate	0.32			
	40-60	---	---	---	---	---	---	-----------	----			
10---------------- Beckman	0-11	40-60	1.25-1.45	<0.06	0.12-0.18	7.9-8.4	<8	High-------	0.37	1	4	.5-3
	11-80	40-60	1.35-1.60	<0.06	0.08-0.12	7.9-8.4	4-16	High-------	0.37			
11---------------- Carey	0-15	10-18	1.30-1.55	0.6-2.0	0.15-0.20	6.6-7.8	<2	Low--------	0.37	5	5	1-3
	15-65	18-35	1.45-1.70	0.6-2.0	0.15-0.20	6.6-8.4	<2	Low--------	0.37			
	65-80	---	---	---	---	---	---	-----------	----			
12---------------- Clairemont	0-80	18-35	1.30-1.65	0.6-2.0	0.16-0.22	7.9-8.4	<2	Low--------	0.37	5	4L	1-2
13*:												
Cornick----------	0-5	15-27	1.30-1.50	0.6-2.0	0.18-0.22	7.9-8.4	<2	Low--------	0.37	1	4L	1-2
	5-10	---	---	---	---	---	---	-----------	----			
	10-15	---	---	---	---	---	---	-----------	----			
Vinson-----------	0-18	15-27	1.30-1.50	0.6-2.0	0.15-0.22	7.4-8.4	<2	Low--------	0.37	2	4L	1-2
	18-25	18-30	1.45-1.70	0.6-2.0	0.15-0.22	7.9-8.4	<2	Moderate	0.37			
	25-30	---	---	---	---	---	---	-----------	----			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	Mmhos/cm					Pct
13*:												
Rock outcrop.												
14----------------	0-12	2-8	1.35-1.50	2.0-6.0	0.07-0.11	6.6-7.8	<2	Low--------	0.17	5	2	.5-2
Devol	12-35	8-18	1.50-1.70	2.0-6.0	0.11-0.15	6.6-7.8	<2	Low--------	0.20			
	35-44	2-15	1.50-1.70	2.0-6.0	0.07-0.15	6.6-8.4	<2	Low--------	0.20			
	44-80	2-10	1.50-1.70	2.0-6.0	0.08-0.12	6.6-8.4	<2	Low--------	0.17			
15----------------	0-15	2-8	1.35-1.50	2.0-6.0	0.07-0.11	6.6-7.8	<2	Low--------	0.17	5	2	.5-2
Devol	15-48	8-18	1.50-1.70	2.0-6.0	0.11-0.15	6.6-7.8	<2	Low--------	0.20			
	48-62	2-15	1.50-1.70	2.0-6.0	0.07-0.15	6.6-8.4	<2	Low--------	0.20			
	62-80	2-10	1.50-1.70	2.0-6.0	0.08-0.12	6.6-8.4	<2	Low--------	0.17			
16----------------	0-6	2-8	1.35-1.50	2.0-6.0	0.07-0.11	6.6-7.8	<2	Low--------	0.17	5	2	.5-2
Devol	6-25	8-18	1.50-1.70	2.0-6.0	0.11-0.15	6.6-7.8	<2	Low--------	0.20			
	25-42	2-15	1.50-1.70	2.0-6.0	0.07-0.15	6.6-8.4	<2	Low--------	0.20			
	42-80	2-10	1.50-1.70	2.0-6.0	0.08-0.12	6.6-8.4	<2	Low--------	0.17			
17----------------	0-9	8-18	1.30-1.60	2.0-6.0	0.11-0.15	6.6-7.8	<2	Low--------	0.20	5	3	.5-2
Devol	9-34	8-18	1.50-1.70	2.0-6.0	0.11-0.15	6.6-7.8	<2	Low--------	0.20			
	34-44	2-15	1.50-1.70	2.0-6.0	0.07-0.15	6.6-8.4	<2	Low--------	0.20			
	44-80	2-10	1.50-1.70	2.0-6.0	0.08-0.12	6.6-8.4	<2	Low--------	0.17			
18----------------	0-14	10-18	1.30-1.60	0.6-6.0	0.11-0.15	6.6-8.4	4-16	Low--------	0.20	1	3	.5-1
Gracemont	14-80	10-18	1.45-1.65	0.6-6.0	0.11-0.20	7.9-8.4	4-16	Low--------	0.32			
19----------------	0-12	15-28	1.30-1.55	2.0-6.0	0.13-0.20	7.4-8.4	4-16	Low--------	0.32	5	5	.5-1
Gracemore	12-80	2-10	1.50-1.70	2.0-20	0.05-0.11	7.9-8.4	4-16	Low--------	0.17			
20----------------	0-15	5-10	1.35-1.50	2.0-6.0	0.07-0.11	6.1-7.8	<2	Low--------	0.20	5	2	.5-1
Grandfield	15-38	18-30	1.50-1.70	0.6-2.0	0.11-0.17	6.1-7.8	<2	Low--------	0.32			
	38-68	18-30	1.50-1.70	0.6-2.0	0.11-0.17	6.6-8.4	<2	Low--------	0.32			
	68-90	15-25	1.50-1.70	2.0-6.0	0.11-0.15	6.6-8.4	<2	Low--------	0.28			
21----------------	0-11	5-10	1.35-1.50	2.0-6.0	0.07-0.11	6.1-7.8	<2	Low--------	0.20	5	2	.5-1
Grandfield	11-20	18-30	1.50-1.70	0.6-2.0	0.11-0.17	6.1-7.8	<2	Low--------	0.32			
	20-44	18-30	1.50-1.70	0.6-2.0	0.11-0.17	6.6-8.4	<2	Low--------	0.32			
	44-80	15-25	1.50-1.70	2.0-6.0	0.11-0.15	6.6-8.4	<2	Low--------	0.28			
22----------------	0-9	10-18	1.30-1.60	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low--------	0.24	5	3	.5-1
Grandfield	9-14	18-30	1.50-1.70	0.6-2.0	0.11-0.17	6.1-7.8	<2	Low--------	0.32			
	14-38	18-30	1.50-1.70	0.6-2.0	0.11-0.17	6.6-8.4	<2	Low--------	0.32			
	38-80	15-25	1.50-1.70	2.0-6.0	0.11-0.15	6.6-8.4	<2	Low--------	0.28			
23----------------	0-7	10-18	1.30-1.60	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low--------	0.24	5	3	.5-1
Grandfield	7-14	18-30	1.50-1.70	0.6-2.0	0.11-0.17	6.1-7.8	<2	Low--------	0.32			
	14-41	18-30	1.50-1.70	0.6-2.0	0.11-0.17	6.6-8.4	<2	Low--------	0.32			
	41-80	15-25	1.50-1.70	2.0-6.0	0.11-0.15	6.6-8.4	<2	Low--------	0.28			
24----------------	0-18	3-10	1.35-1.50	2.0-6.0	0.07-0.11	6.6-8.4	<2	Low--------	0.20	5	2	<1
Grandmore	18-31	18-30	1.50-1.70	0.6-2.0	0.11-0.17	7.4-8.4	<2	Low--------	0.32			
	31-80	30-45	1.35-1.65	0.2-0.6	0.12-0.20	7.4-8.4	<2	Moderate	0.32			
25, 26------------	0-9	10-18	1.30-1.60	2.0-6.0	0.11-0.15	7.4-8.4	<2	Very low	0.20	5	3	.5-1
Hardeman	9-80	12-18	1.40-1.70	2.0-6.0	0.10-0.15	7.4-8.4	<2	Very low	0.28			
27----------------	0-11	10-18	1.30-1.60	2.0-6.0	0.11-0.15	7.4-8.4	<2	Very low	0.20	5	3	.5-1
Hardeman	11-80	12-18	1.40-1.70	2.0-6.0	0.10-0.15	7.4-8.4	<2	Very low	0.28			
28----------------	0-5	10-18	1.30-1.60	2.0-6.0	0.11-0.15	7.4-8.4	<2	Very low	0.20	5	3	.5-1
Hardeman	5-80	12-18	1.40-1.70	2.0-6.0	0.10-0.15	7.4-8.4	<2	Very low	0.28			
29----------------	0-14	10-18	1.30-1.60	2.0-6.0	0.11-0.15	7.4-8.4	<2	Very low	0.20	5	3	.5-1
Hardeman	14-56	12-18	1.40-1.70	2.0-6.0	0.10-0.15	7.4-8.4	<2	Very low	0.28			
	56-80	10-18	1.60-1.70	6.0-20	0.07-0.11	7.4-8.4	<2	Very low	0.17			
30*:												
Hardeman---------	0-10	10-18	1.30-1.60	2.0-6.0	0.10-0.15	7.4-8.4	<2	Very low	0.20	5	3	.5-1
	10-80	12-18	1.40-1.70	2.0-6.0	0.10-0.15	7.4-8.4	<2	Very low	0.28			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	Mmhos/cm					Pct
30*:												
Likes-----------	0-11	5-10	1.35-1.50	6.0-20	0.03-0.10	7.9-8.4	<2	Low--------	0.15	5	2	.5-1
	11-80	1-10	1.50-1.70	6.0-20	0.03-0.11	7.9-8.4	<2	Low--------	0.15			
Devol-----------	0-8	8-18	1.30-1.60	2.0-6.0	0.11-0.15	6.6-7.8	<2	Low--------	0.20	5	3	.5-2
	8-24	8-18	1.50-1.70	2.0-6.0	0.11-0.15	6.6-7.8	<2	Low--------	0.20			
	24-38	2-15	1.50-1.70	2.0-6.0	0.07-0.15	6.6-8.4	<2	Low--------	0.20			
	38-80	2-10	1.50-1.70	2.0-6.0	0.08-0.12	6.6-8.4	<2	Low--------	0.17			
31--------------- Hollister	0-21	28-35	1.30-1.60	0.2-0.6	0.15-0.20	6.6-8.4	<2	High-------	0.32	5	6	1-3
	21-70	35-50	1.35-1.65	0.06-0.2	0.12-0.18	7.4-8.4	<2	High-------	0.32			
	70-80	35-50	1.35-1.65	0.06-0.2	0.11-0.17	7.9-8.4	<2	High-------	0.32			
32*:												
Knoco-----------	0-8	40-60	1.25-1.45	<0.06	0.10-0.17	7.9-8.4	<2	High-------	0.37	1	4	<1
	8-40	40-60	1.60-1.75	<0.06	0.01-0.08	7.9-8.4	<2	High-------	0.37			
Aspermont--------	0-6	18-27	1.30-1.55	0.6-2.0	0.16-0.24	7.9-8.4	<2	Low--------	0.37	4	4L	.5-2
	6-80	27-35	1.45-1.70	0.6-2.0	0.12-0.18	7.9-8.4	<2	Moderate	0.32			
33*:												
Knoco-----------	0-9	40-60	1.25-1.45	<0.06	0.10-0.17	7.9-8.4	<2	High-------	0.37	1	4	<1
	9-40	40-60	1.60-1.75	<0.06	0.01-0.08	7.9-8.4	<2	High-------	0.37			
Badland.												
34*:												
Knoco-----------	0-10	40-60	1.25-1.45	<0.06	0.10-0.17	7.9-8.4	<2	High-------	0.37	1	4	<1
	10-30	40-60	1.60-1.75	<0.06	0.01-0.08	7.9-8.4	<2	High-------	0.37			
Cornick----------	0-9	15-27	1.30-1.50	0.6-2.0	0.18-0.22	7.9-8.4	<2	Low--------	0.37	1	4L	1-2
	9-20	---	---	---	---	---	---	-----------	----			
Rock outcrop.												
35*:												
Knoco-----------	0-6	40-60	1.25-1.45	<0.06	0.10-0.17	7.9-8.4	<2	High-------	0.37	1	4	<1
	6-20	40-60	1.60-1.75	<0.06	0.01-0.08	7.9-8.4	<2	High-------	0.37			
Rock outcrop.												
36--------------- Likes	0-6	1-10	1.35-1.50	6.0-20	0.05-0.08	7.4-8.4	<2	Very low	0.17	5	1	<.5
	6-80	1-10	1.50-1.70	6.0-20	0.02-0.08	7.9-8.4	<2	Very low	0.17			
37--------------- Lincoln	0-9	5-15	1.35-1.50	6.0-20	0.06-0.11	7.4-8.4	<2	Low--------	0.17	5	2	<.5
	9-80	5-15	1.30-1.60	6.0-20	0.02-0.08	7.9-8.4	<2	Low--------	0.17			
38--------------- Madge	0-14	15-25	1.30-1.55	0.6-2.0	0.15-0.20	6.1-7.8	<2	Low--------	0.37	5	5	1-3
	14-43	18-35	1.40-1.65	0.6-2.0	0.12-0.20	6.6-8.4	<2	Low--------	0.37			
	43-80	10-25	1.40-1.65	0.6-6.0	0.11-0.20	6.6-8.4	<2	Low--------	0.37			
39--------------- Madge	0-13	15-25	1.30-1.55	0.6-2.0	0.15-0.20	6.1-7.8	<2	Low--------	0.37	5	5	1-3
	13-41	18-35	1.40-1.65	0.6-2.0	0.12-0.20	6.6-8.4	<2	Low--------	0.37			
	41-57	10-25	1.40-1.65	0.6-6.0	0.11-0.20	6.6-8.4	<2	Low--------	0.37			
	57-80	10-25	1.40-1.65	0.6-6.0	0.11-0.20	7.4-8.4	<2	Low--------	0.37			
40--------------- Mangum	0-7	20-40	1.30-1.60	0.2-0.6	0.15-0.20	7.9-8.4	<2	Moderate	0.32	5	4L	.5-2
	7-21	40-60	1.25-1.45	<0.06	0.14-0.18	7.9-8.4	<4	High-------	0.37			
	21-65	30-45	1.25-1.45	<0.06	0.15-0.20	7.9-8.4	<4	Moderate	0.43			
41--------------- Mangum	0-11	40-60	1.25-1.45	<0.06	0.14-0.18	7.9-8.4	<2	High-------	0.37	5	4	.5-2
	11-57	40-60	1.25-1.45	<0.06	0.14-0.18	7.9-8.4	<4	High-------	0.37			
	57-80	30-45	1.25-1.45	<0.06	0.15-0.20	7.9-8.4	<4	Moderate	0.37			
42--------------- McKnight	0-8	5-10	1.35-1.50	2.0-6.0	0.07-0.11	6.6-8.4	<2	Low--------	0.24	3	2	<1
	8-33	18-35	1.50-1.70	0.6-2.0	0.12-0.17	6.6-8.4	<2	Low--------	0.37			
	33-45	35-60	1.35-1.65	0.06-0.6	0.12-0.22	7.9-8.4	<2	High-------	0.32			
	45-60	---	---	---	---	---	---	-----------	----			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	Mmhos/cm					Pct
43---------------- McKnight	0-7	5-10	1.35-1.50	2.0-6.0	0.07-0.11	6.6-8.4	<2	Low--------	0.24	3	2	<1
	7-35	18-35	1.50-1.70	0.6-2.0	0.12-0.17	6.6-8.4	<2	Low--------	0.37			
	35-50	35-60	1.35-1.65	0.06-0.6	0.12-0.22	7.9-8.4	<2	High-------	0.32			
	50-80	---	---	---	---	---	---	-----------	----			
44---------------- McKnight	0-7	10-18	1.30-1.60	2.0-6.0	0.11-0.15	6.6-8.4	<2	Low--------	0.32	3	3	<1
	7-35	18-35	1.50-1.70	0.6-2.0	0.12-0.17	6.6-8.4	<2	Low--------	0.37			
	35-53	35-60	1.35-1.65	0.06-0.6	0.12-0.22	7.9-8.4	<2	High-------	0.32			
	53-80	---	---	---	---	---	---	-----------	----			
45---------------- Nobscot	0-27	2-10	1.50-1.70	2.0-6.0	0.05-0.11	5.6-7.3	<2	Low--------	0.17	5	2	<1
	27-40	8-15	1.50-1.70	2.0-6.0	0.10-0.15	5.1-6.5	<2	Low--------	0.20			
	40-72	2-12	1.50-1.70	2.0-6.0	0.05-0.11	5.1-6.5	<2	Low--------	0.17			
	72-80	2-10	1.50-1.70	2.0-6.0	0.05-0.11	6.1-7.3	<2	Low--------	0.17			
46---------------- Nobscot	0-39	2-10	1.50-1.70	2.0-6.0	0.05-0.11	5.6-7.3	<2	Low--------	0.17	5	2	<1
	39-50	8-15	1.50-1.70	2.0-6.0	0.10-0.15	5.1-6.5	<2	Low--------	0.20			
	50-85	2-12	1.50-1.70	2.0-6.0	0.05-0.11	5.1-6.5	<2	Low--------	0.17			
47*:												
Quanah-----------	0-14	27-35	1.30-1.60	0.6-2.0	0.15-0.20	7.9-8.4	<2	Low--------	0.37	4	4L	1-3
	14-36	18-33	1.45-1.70	0.6-2.0	0.15-0.20	7.9-8.4	<2	Low--------	0.37			
	36-80	18-35	1.45-1.70	0.6-2.0	0.10-0.16	7.9-8.4	<2	Low--------	0.37			
Talpa------------	0-11	18-27	1.30-1.70	0.6-2.0	0.12-0.18	7.9-8.4	<2	Low--------	0.32	1	4L	1-3
	11-15	---	---	---	---	---	---	-----------	----			
48*:												
Quinlan----------	0-10	15-27	1.30-1.55	0.6-2.0	0.13-0.24	7.4-8.4	<2	Low--------	0.32	2	4L	<1
	10-40	---	---	---	---	---	---	-----------	----			
Rock outcrop.												
49*:												
Quinlan----------	0-17	15-27	1.30-1.55	0.6-2.0	0.13-0.24	7.4-8.4	<2	Low--------	0.32	2	4L	<1
	17-60	---	---	---	---	---	---	-----------	----			
Woodward---------	0-29	10-18	1.30-1.65	0.6-2.0	0.13-0.20	6.6-8.4	<2	Low--------	0.37	3	4L	.5-2
	29-60	---	---	---	---	---	---	-----------	----			
50. Salt flats												
51---------------- Shrewder	0-16	10-18	1.30-1.60	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low--------	0.20	5	3	<.-1
	16-49	10-18	1.40-1.70	2.0-6.0	0.11-0.20	6.6-8.4	<2	Low--------	0.32			
	49-77	10-18	1.40-1.70	2.0-6.0	0.07-0.20	7.4-8.4	<2	Low--------	0.32			
	77-80	---	---	---	---	---	---	-----------	----			
52---------------- Shrewder	0-11	10-18	1.30-1.60	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low--------	0.20	5	3	<1
	11-49	10-18	1.40-1.70	2.0-6.0	0.11-0.20	6.6-8.4	<2	Low--------	0.32			
	49-62	10-18	1.40-1.70	2.0-6.0	0.07-0.20	7.4-8.4	<2	Low--------	0.32			
	62-80	---	---	---	---	---	---	-----------	----			
53---------------- Spur	0-11	20-35	1.30-1.7	0.6-2.0	0.14-0.20	7.9-8.4	<2	Moderate	0.32	5	4L	1.0-2.0
	11-80	20-35	1.45-1.70	0.6-2.0	0.14-0.20	7.9-8.4	<2	Moderate	0.32			
54---------------- Spur	0-18	20-35	1.30-1.60	0.6-2.0	0.14-0.20	7.9-8.4	<2	Moderate	0.32	5	4L	1.0-2.0
	18-80	20-35	1.45-1.70	0.6-2.0	0.14-0.20	7.9-8.4	<2	Moderate	0.32			
55---------------- Tillman	0-12	27-35	1.30-1.45	0.2-0.6	0.15-0.20	6.6-8.4	<2	High-------	0.37	5	4L	1-3
	12-60	35-50	1.45-1.65	0.06-0.2	0.12-0.18	7.4-8.4	<2	High-------	0.32			
	60-80	35-55	1.45-1.70	0.06-0.2	0.11-0.17	7.9-8.4	<2	High-------	0.32			
56---------------- Tillman	0-12	27-35	1.30-1.45	0.2-0.6	0.15-0.20	6.6-8.4	<2	High-------	0.37	5	4L	1-3
	12-51	35-50	1.45-1.65	0.06-0.2	0.12-0.18	7.4-8.4	<2	High-------	0.32			
	51-80	35-55	1.45-1.70	0.06-0.2	0.11-0.17	7.9-8.4	<2	High-------	0.32			
57---------------- Tipton	0-9	15-20	1.30-1.55	0.6-2.0	0.15-0.20	6.6-7.8	<2	Low--------	0.37	5	5	1-2
	9-80	20-32	1.40-1.70	0.6-2.0	0.15-0.20	6.6-8.4	<2	Low--------	0.32			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	Mmhos/cm					Pct
58---------------- Tipton	0-8	15-20	1.30-1.55	0.6-2.0	0.15-0.20	6.6-7.8	<2	Low--------	0.37	5	5	1-2
	8-80	20-32	1.40-1.70	0.6-2.0	0.15-0.20	6.6-8.4	<2	Low--------	0.32			
59---------------- Tivoli	0-13	1-10	1.35-1.50	6.0-20	0.02-0.08	6.1-7.8	<2	Low--------	0.17	5	1	<1
	13-80	1-10	1.50-1.70	6.0-20	0.02-0.08	6.1-8.4	<2	Low--------	0.17			
60*:												
Likes------------	0-11	5-10	1.35-1.50	6.0-20	0.03-0.10	7.9-8.4	<2	Low--------	0.15	5	2	.5-1
	11-80	1-10	1.50-1.70	6.0-20	0.03-0.11	7.9-8.4	<2	Low--------	0.15			
Devol------------	0-6	2-8	1.35-1.50	2.0-6.0	0.07-0.11	6.6-7.8	<2	Low--------	0.17	5	2	.5-2
	6-24	8-18	1.50-1.70	2.0-6.0	0.11-0.15	6.6-7.8	<2	Low--------	0.20			
	24-36	2-15	1.50-1.70	2.0-6.0	0.07-0.15	6.6-8.4	<2	Low--------	0.20			
	36-80	2-10	1.50-1.70	2.0-6.0	0.08-0.12	6.6-8.4	<2	Low--------	0.17			
61. Ustorthents												
62---------------- Vernon	0-7	35-40	1.45-1.70	0.06-0.2	0.12-0.17	7.9-8.4	<2	High-------	0.43	2	4L	.5-2
	7-34	40-60	1.30-1.60	<0.06	0.10-0.15	7.9-8.4	<2	High-------	0.32			
	34-60	40-60	1.30-1.60	<0.06	0.01-0.10	7.9-8.4	<2	High-------	0.32			
63---------------- Vernon	0-7	35-40	1.45-1.70	0.06-0.2	0.12-0.17	7.9-8.4	<2	High-------	0.43	2	4L	.5-2
	7-38	40-60	1.30-1.60	<0.06	0.10-0.15	7.9-8.4	<2	High-------	0.32			
	38-80	40-60	1.30-1.60	<0.06	0.01-0.10	7.9-8.4	<2	High-------	0.32			
64---------------- Vernon	0-8	35-40	1.45-1.70	0.06-0.2	0.12-0.17	7.9-8.4	<2	High-------	0.43	1	4L	.5-2
	8-21	40-60	1.30-1.60	<0.06	0.10-0.15	7.9-8.4	<2	High-------	0.32			
	21-80	40-60	1.30-1.60	<0.06	0.01-0.10	7.9-8.4	<2	High-------	0.32			
65*:												
Vernon-----------	0-4	35-40	1.45-1.70	0.06-0.2	0.12-0.17	7.9-8.4	<2	High-------	0.43	2	4	.5-2
	4-24	40-60	1.30-1.60	<0.06	0.10-0.15	7.9-8.4	<2	High-------	0.32			
	24-80	40-60	1.30-1.60	<0.06	0.01-0.10	7.9-8.4	<2	High-------	0.32			
Knoco------------	0-8	40-60	1.25-1.45	<0.06	0.10-0.17	7.9-8.4	<2	High-------	0.37	1	4	<1
	8-80	40-60	1.60-1.75	<0.06	0.01-0.08	7.9-8.4	<2	High-------	0.37			
66---------------- Westview	0-6	27-30	1.30-1.60	0.6-2.0	0.18-0.22	6.6-8.4	<2	Moderate	0.32	5	7	1-3
	6-36	27-35	1.45-1.70	0.2-0.6	0.15-0.22	7.4-8.4	<2	Moderate	0.32			
	36-80	18-35	1.40-1.70	0.6-2.0	0.15-0.24	7.9-8.4	<2	Moderate	0.37			
67---------------- Woodward	0-38	10-18	1.30-1.60	0.6-2.0	0.13-0.20	6.6-8.4	<2	Low--------	0.37	3	4L	.5-2
	38-60	---	---	---	---	---	---	-----------	----			
68---------------- Woodward	0-28	10-18	1.30-1.60	0.6-2.0	0.13-0.20	6.6-8.4	<2	Low--------	0.37	3	6L	.5-2
	28-60	---	---	---	---	---	---	-----------	----			
69*:												
Woodward---------	0-35	10-18	1.30-1.60	0.6-2.0	0.13-0.20	6.6-8.4	<2	Low--------	0.37	3	4L	.5-2
	35-60	---	---	---	---	---	---	-----------	----			
Quinlan----------	0-14	15-27	1.30-1.55	0.6-2.0	0.13-0.24	7.4-8.4	<2	Low--------	0.32	2	4L	<1
	14-40	---	---	---	---	---	---	-----------	----			
70*:												
Woodward---------	0-25	10-18	1.30-1.60	0.6-2.0	0.13-0.20	6.6-8.4	<2	Low--------	0.37	3	4L	.5-2
	25-60	---	---	---	---	---	---	-----------	----			
Quinlan----------	0-13	15-27	1.30-1.55	0.6-2.0	0.13-0.24	7.4-8.4	<2	Low--------	0.32	2	4L	<1
	13-40	---	---	---	---	---	---	-----------	----			
71*:												
Woodward---------	0-26	10-18	1.30-1.60	0.6-2.0	0.13-0.20	6.6-8.4	<2	Low--------	0.37	3	4L	.5-2
	26-40	---	---	---	---	---	---	-----------	----			
Quinlan----------	0-12	15-27	1.30-1.55	0.6-2.0	0.13-0.24	7.4-8.4	<2	Low--------	0.32	2	4L	<1
	12-20	---	---	---	---	---	---	-----------	----			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm^3	In/hr	In/in	pH	Mmhos/cm					Pct
72---------------- Yahola	0-12	10-18	1.30-1.60	2.0-6.0	0.11-0.15	7.4-8.4	<2	Low--------	0.20	5	3	.5-1
	12-80	5-18	1.40-1.70	2.0-6.0	0.11-0.20	7.9-8.4	<2	Low--------	0.20			
73---------------- Yahola	0-5	10-18	1.30-1.60	2.0-6.0	0.11-0.15	7.4-8.4	<2	Low--------	0.20	5	3	.5-1
	5-80	5-18	1.40-1.70	2.0-6.0	0.11-0.20	7.9-8.4	<2	Low--------	0.20			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Map symbol and soil name	Hydro-logic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	Uncoated steel	Concrete
					Ft			In			
1, 2 Abilene	C	None	---	---	>6.0	---	---	>60	---	High	Low.
3*, 4*:											
Acme	B	None	---	---	>6.0	---	---	>60	---	High	Moderate.
Vinson	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low.
5, 6 Altus	B	None	---	---	>6.0	---	---	>60	---	Low	Low.
7, 8, 9 Aspermont	B	None	---	---	>6.0	---	---	40-60	Soft	Moderate	Low.
10 Beckman	D	Occasional	Very brief	Apr-Oct	>6.0	---	---	>60	---	High	Moderate.
11 Carey	B	None	---	---	>6.0	---	---	40-70	Soft	Moderate	Low.
12 Clairemont	B	Occasional	Very brief	Apr-Nov	>6.0	---	---	>60	---	Moderate	Low.
13*:											
Cornick	D	None	---	---	>6.0	---	---	5-10	Soft	High	Moderate.
Vinson	B	None	---	---	>6.0	---	---	20-40	Soft	Moderate	Low.
Rock outcrop.											
14, 15, 16, 17 Devol	B	None	---	---	>6.0	---	---	>60	---	Low	Low.
18 Gracemont	B	Frequent	Very brief to brief.	Mar-Aug	0.5-3.5	Apparent	Nov-May	>60	---	High	High.
19 Gracemore	C	Frequent	Very brief	Mar-Aug	0.5-3.5	Apparent	Nov-May	>60	---	High	High.
20, 21, 22, 23 Grandfield	B	None	---	---	>6.0	---	---	>60	---	Low	Low.
24 Grandmore	B	None	---	---	>6.0	---	---	>60	---	High	Low.
25, 26, 27, 28, 29 Hardeman	B	None	---	---	>6.0	---	---	>60	---	Low	Low.
30*:											
Hardeman	B	None	---	---	>6.0	---	---	>60	---	Low	Low.
Likes	A	None	---	---	>6.0	---	---	>60	---	Low	Low.
Devol	B	None	---	---	>6.0	---	---	>60	---	Low	Low.
31 Hollister	D	None	---	---	>6.0	---	---	>60	---	High	Low.
32*:											
Knoco	D	None	---	---	>6.0	---	---	3-12	Soft	High	Low.
Aspermont	B	None	---	---	>6.0	---	---	40-60	Soft	Moderate	Low.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydro-logic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	Uncoated steel	Concrete
					Ft			In			
33*: Knoco	D	None	---	---	>6.0	---	---	3-12	Soft	High	Low.
Badland.											
34*: Knoco	D	None	---	---	>6.0	---	---	3-12	Soft	High	Low.
Cornick	D	None	---	---	>6.0	---	---	5-10	Soft	High	Moderate.
Rock outcrop.											
35*: Knoco	D	None	---	---	>6.0	---	---	3-12	Soft	High	Low.
Rock outcrop.											
36 Likes	A	None	---	---	>6.0	---	---	>60	---	Low	Low.
37 Lincoln	A	Frequent	Very brief	Apr-Oct	5.0-8.0	Apparent	Nov-May	>60	---	Low	Low.
38, 39 Madge	B	None	---	---	>6.0	---	---	>60	---	Low	Low.
40 Mangum	D	Occasional	Very brief	Apr-Nov	>6.0	---	---	>60	---	High	Low.
41 Mangum	D	Rare	---	---	>6.0	---	---	>60	---	High	Low.
42, 43, 44 McKnight	B	None	---	---	>6.0	---	---	30-50	Soft	Moderate	Low.
45, 46 Nobscot	A	None	---	---	>6.0	---	---	>60	---	Low	Moderate.
47*: Quanah	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low.
Talpa	D	None	---	---	>6.0	---	---	5-14	Hard	High	Low.
48*: Quinlan	C	None	---	---	>6.0	---	---	10-20	Soft	Moderate	Low.
Rock outcrop.											
49*: Quinlan	C	None	---	---	>6.0	---	---	10-20	Soft	Moderate	Low.
Woodward	B	None	---	---	>6.0	---	---	20-40	Soft	Low	Low.
50. Salt flats											
51, 52 Shrewder	B	None	---	---	>6.0	---	---	>60	---	Low	Low.
53 Spur	B	Occasional	Very brief	Apr-Oct	>6.0	---	---	>60	---	Moderate	Low.
54 Spur	B	Frequent	Very brief	Apr-Oct	>6.0	---	---	>60	---	Moderate	Low.
55, 56 Tillman	C	None	---	---	>6.0	---	---	>60	---	High	Low.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydro-logic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	Uncoated steel	Concrete
					Ft			In			
57, 58------------ Tipton	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
59---------------- Tivoli	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low.
60*:											
Likes------------	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low.
Devol------------	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low.
61. Ustorthents											
62, 63, 64-------- Vernon	D	None--------	---	---	>6.0	---	---	20-40	Soft	High-----	Low.
65*:											
Vernon-----------	D	None--------	---	---	>6.0	---	---	20-40	Soft	High-----	Low.
Knoco------------	D	None--------	---	---	>6.0	---	---	3-12	Soft	High-----	Low.
66---------------- Westview	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
67, 68------------ Woodward	B	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	Low.
69*, 70*, 71*:											
Woodward---------	B	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	Low.
Quinlan----------	C	None--------	---	---	>6.0	---	---	10-20	Soft	Moderate	Low.
72---------------- Yahola	B	Rare--------	---	---	>6.0	---	---	>60	---	Low------	Low.
73---------------- Yahola	B	Occasional	Very brief	Apr-Oct	>6.0	---	---	>60	---	Low------	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--PHYSICAL ANALYSES OF SELECTED SOILS

Soil series and sample number	Depth	Horizon	Particle-size distribution							
			Very coarse sand (2.0-1.0 mm)	Coarse sand (1.0-0.5 mm)	Medium sand (0.5-0.25 mm)	Fine sand (0.25-0.10 mm)	Very fine sand (0.10-0.05 mm)	Total sand (2.0-0.05 mm)	Silt (0.05-0.002 mm	Clay (0.002 mm)
	In		Pct	Pct	Pct	Pct	Pct	Pct	Pct	Pct
Aspermont:1,2/ 80-OK-29-10										
	0-7	Ap	0.4	0.3	0.7	3.9	20.7	26.0	60.1	13.4
	7-14	A1	0.6	0.3	0.7	4.8	17.7	24.1	60.1	15.8
	14-21	B21	0.6	0.5	0.8	2.7	20.2	24.8	55.9	19.3
	21-29	B22	0.6	0.3	0.5	3.3	18.2	22.9	55.4	21.7
	29-38	B3ca	3.9	1.9	1.5	3.3	10.9	21.5	55.0	23.5
	38-41	Cca	1.8	2.3	1.8	4.3	14.1	24.3	51.5	24.2
	41-80	Cr	11.7	8.3	5.9	5.9	4.0	35.8	40.7	23.5
Beckman:2/ S80-OK-29-3										
	0-11	A	0.1	0.1	0.1	0.2	1.1	1.6	45.2	53.2
	11-20	C1	0.1	0.1	0.1	0.2	0.8	1.3	38.6	60.1
	20-44	C2	0.1	0.1	0.2	0.4	2.0	2.8	39.6	57.6
	44-80	C3	0.1	0.1	0.2	0.6	4.6	5.7	44.0	50.3
Carey:3/ S79-OK-29-1										
	0-8	Ap	0.1	0.1	0.3	8.6	47.2	56.2	28.1	15.7
	8-13	A1	0.1	0.1	0.3	4.8	31.1	36.4	42.3	21.3
	13-23	B21t	0.1	0.1	0.3	4.8	29.4	34.7	32.1	33.2
	23-34	B22t	0.1	0.1	0.4	7.6	37.6	45.8	27.9	26.3
	34-43	B23t	0.1	0.1	0.3	9.5	44.2	54.3	26.3	19.4
	43-56	B31	0.1	0.1	0.2	10.6	47.7	58.7	23.1	18.2
	56-71	B3ca	0.3	0.3	0.8	5.7	43.6	50.7	29.6	19.6
	71-80	Cr	0.1	0.1	0.2	3.2	49.2	52.8	35.9	11.3
Madge:2/ S80-OK-29-1										
	0-9	Ap	0.1	0.1	2.2	35.1	14.7	52.3	30.6	17.2
	9-13	A1	0.1	0.2	2.8	22.7	17.8	43.5	32.0	24.4
	13-18	B1	0.1	0.2	2.7	20.7	15.7	39.3	29.4	31.3
	18-25	B21t	0.1	0.2	2.9	18.8	16.9	38.9	28.3	32.8
	25-41	B22t	0.1	0.2	3.7	31.6	15.2	50.7	22.8	26.5
	41-57	B3	0.1	0.2	4.1	29.2	15.1	48.7	33.1	18.2
	57-80	C	0.1	0.2	5.1	55.7	13.3	74.4	14.3	11.3
Shrewder:2/ 80-OK-29-5										
	0-8	Ap	0.1	0.2	2.9	30.9	27.1	61.1	23.8	15.0
	8-16	A1	0.1	0.2	2.2	22.0	28.4	52.9	31.4	15.7
	16-31	B2	0.1	0.1	1.3	18.1	31.0	50.7	34.0	15.4
	31-49	B3	0.1	0.2	0.8	21.1	30.0	52.1	36.6	11.3
	49-77	C	0.1	0.4	1.4	8.8	45.5	56.2	33.7	10.1
	77-80	IICr	0.2	0.1	0.2	6.5	50.9	57.8	33.6	8.6
Westview:4/ 80-OK-29-25										
	0-6	Ap	0.1	1.1	9.5	8.2	14.4	33.3	39.1	27.5
	6-19	B21t	0.1	0.3	2.8	4.8	16.5	24.4	41.8	33.8
	19-33	B22t	0.1	0.2	1.1	3.4	13.2	18.0	38.8	43.2
	33-57	B3	1.3	0.1	0.8	3.3	16.7	22.3	43.6	34.1
	57-80	C	0.1	0.2	4.5	29.7	25.2	59.6	27.8	12.5

1/The clay content of the A horizon is slightly less than common for the Aspermont series.
2/Typical pedon for the series.
3/Depth to secondary lime is slightly deeper than allowed for the Carey series, thus this pedon is a taxadjunct to the Carey series. This pedon is located 1,300 feet west and 400 feet south of the northwest corner of sec. 21, T. 5 N., R. 26 W.
4/The B22t horizon is slightly more clayey than allowed for the Westview series, thus this pedon is a taxadjunct to the Westview series. This pedon is located 1,500 feet south and 640 feet west of northeast corner of sec. 5, T. 2 N., R. 26 W.

TABLE 19.--CHEMICAL ANALYSES OF SELECTED SOILS

[Absence of an entry indicates data were not available]

Soil series and sample number	Depth	Horizon	Extractable bases (milliequivalents per 100 grams of soil) Ca	Mg	K	Na	Cation exchange capacity	Base saturation	Reaction (1:1 soil-water)	Organic matter	Total phosphorus
	In							Pct	pH	Pct	P/M
Aspermont:1,2/ S80-OK-29-10	0-7	Ap	32.14	6.59	0.88	0.04	11.9	99.3	7.9	1.59	69.8
	7-14	A1	37.90	9.06	0.61	0.05	14.7	98.6	7.9	1.54	66.0
	14-21	B21	37.90	9.06	0.34	0.10	18.1	98.0	7.9	1.34	66.0
	21-29	B22	36.26	8.24	0.37	0.14	18.2	96.8	8.0	1.01	66.0
	29-38	B3ca	33.78	9.06	0.30	0.15	18.7	95.5	8.1	0.66	88.5
	38-41	Cca	35.02	8.03	0.25	0.27	17.0	95.8	8.3	0.60	88.5
	41-80	Cr	35.02	15.04	0.44	0.90	24.5	94.8	8.2	0.32	88.5
Beckman:2/ S80-OK-29-3	0-11	A	37.95	9.89	2.52	1.49	32.3	95.7	7.6	3.09	---
	11-20	C1	32.80	13.55	1.12	5.44	29.2	99.7	7.6	1.39	---
	20-44	C2	100.00	5.23	0.69	5.52	28.5	99.8	7.6	0.91	---
	44-80	C3	73.58	0.87	0.63	6.14	26.7	97.9	7.6	0.84	
Carey:3/ S79-OK-29-1	0-8	Ap	5.49	2.64	0.58	0.11	12.1	72.8	7.3	1.06	323.8
	8-13	A1	9.07	5.20	0.24	0.08	20.2	72.2	7.3	1.50	327.5
	13-23	B21t	9.72	7.00	0.23	0.09	23.8	79.5	7.4	1.29	290.0
	23-34	B22t	8.25	6.21	0.27	0.07	20.9	81.2	7.4	0.82	268.8
	34-43	B23t	6.50	4.74	0.17	0.05	15.0	79.9	7.5	0.47	292.5
	43-56	B31	5.54	4.10	0.15	0.06	11.7	81.8	7.7	0.29	391.5
	56-71	B3ca	37.87	5.90	0.08	0.07	9.5	97.6	8.4	0.35	425.5
	71-80	Cr	30.58	5.24	0.03	0.09	7.9	97.4	8.4	0.06	539.8
Madge:2/ S80-OK-29-1	0-9	Ap	7.05	2.51	0.71	0.08	12.0	73.2	6.4	1.80	---
	9-13	A1	18.50	5.48	0.42	0.89	18.1	88.6	7.6	1.86	---
	13-18	B1	11.21	4.94	0.50	0.09	20.4	79.4	7.1	1.86	---
	18-25	B21t	11.29	5.69	0.53	0.10	23.3	74.3	6.9	1.72	---
	25-41	B22t	8.73	4.74	0.33	0.10	17.9	73.0	6.9	1.19	---
	41-57	B3	5.77	3.30	0.30	0.09	12.1	69.2	7.2	0.91	---
	57-80	C	21.42	3.91	0.23	0.08	7.7	89.2	7.9	0.86	---
Shrewder:2/ 80-OK-29-5	0-8	Ap	3.28	3.32	0.37	0.04	8.1	73.8	6.6	0.78	---
	8-16	A1	5.77	4.16	0.22	0.04	11.5	82.1	6.9	0.85	---
	16-31	B2	5.77	4.12	0.18	0.06	9.8	86.4	7.2	0.53	---
	31-49	B3	5.81	2.43	0.14	0.04	9.3	86.1	7.3	0.35	---
	49-77	C	27.19	5.85	0.10	0.04	6.6	99.7	8.2	0.20	---
	77-80	IICr	24.80	5.73	0.10	0.05	6.6	99.7	8.1	0.12	---
Westview:4/ 80-OK-29-25	0-6	Ap	19.61	5.23	1.20	0.63	28.1	96.1	7.3	1.84	---
	6-19	B21t	32.75	9.15	1.09	0.45	34.1	95.5	7.2	1.84	---
	19-33	B22t	30.08	11.66	0.66	0.98	28.6	99.8	7.5	0.68	---
	33-57	B3	31.85	15.20	0.79	1.40	35.4	98.2	7.4	1.19	---
	57-80	C	9.72	5.81	0.37	0.39	9.5	99.9	7.5	0.30	---

1/The clay content of the A horizon is slightly less than common for the Aspermont series.
2/Typical pedon for the series.
3/Depth to secondary lime is slightly deeper than allowed for the Carey series, thus this pedon is a taxadjunct to the Carey series. This pedon is located 1,300 feet west and 400 feet south of the northwest corner of sec. 21, T. 5 N., R. 26 W.
4/The B22t horizon is slightly more clayey than allowed for the Westview series, thus this pedon is a taxadjunct to the Westview series. This pedon is located 1,500 feet south and 640 feet west of northeast corner of sec. 5, T. 2 N., R. 26 W.

TABLE 20.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Abilene	Fine, mixed, thermic Pachic Argiustolls
Acme	Loamy, mixed, thermic, shallow Entic Haplustolls
Altus	Fine-loamy, mixed, thermic Pachic Argiustolls
Aspermont	Fine-silty, mixed, thermic Typic Ustochrepts
Beckman	Fine, mixed (calcareous), thermic Vertic Ustifluvents
Carey	Fine-silty, mixed, thermic Typic Argiustolls
Clairemont	Fine-silty, mixed (calcareous), thermic Typic Ustifluvents
Cornick	Loamy, mixed, thermic, shallow Entic Haplustolls
Devol	Coarse-loamy, mixed, thermic Udic Haplustalfs
Gracemont	Coarse-loamy, mixed (calcareous), thermic Aquic Udifluvents
Gracemore	Sandy, mixed, thermic Aquic Udifluvents
Grandfield	Fine-loamy, mixed, thermic Udic Haplustalfs
Grandmore	Fine-loamy, mixed, thermic Udic Haplustalfs
Hardeman	Coarse-loamy, mixed, thermic Typic Ustochrepts
Hollister	Fine, mixed, thermic Pachic Paleustolls
Knoco	Clayey, mixed (calcareous), thermic, shallow Ustic Torriorthents
Likes	Mixed, thermic, Typic Ustipsamments
Likes	Thermic typic ustipsamments Mixed
Lincoln	Sandy, mixed, thermic Typic Ustifluvents
Madge	Fine-loamy, mixed, thermic Udic Argiustolls
Mangum	Fine, mixed, thermic vertic Ustochrepts
McKnight	Fine-loamy, mixed, thermic Typic Haplustalfs
Nobscot	Loamy, mixed, thermic Arenic Paleustalfs
Quanah	Fine-silty, mixed, thermic Typic Calciustolls
Quinlan	Loamy, mixed, thermic, shallow Typic Ustochrepts
Shrewder	Coarse-loamy, mixed, thermic Udic Ustochrepts
Spur	Fine-loamy, mixed, thermic Fluventic Haplustolls
Talpa	Loamy, mixed, thermic Lithic Calciustolls
Tillman	Fine, mixed, thermic Typic Paleustolls
*Tipton	Fine-loamy, mixed, thermic Pachic Argiustolls
*Tivoli	Mixed, thermic Typic Ustipsamments
Ustorthents	Sandy, mixed, thermic Udic Ustorthents
Vernon	Fine, mixed, thermic Typic Ustochrepts
Vinson	Fine-silty, mixed, thermic Entic Haplustolls
Westview	Fine-silty, mixed, thermic Pachic Argiustolls
Woodward	Coarse-silty, mixed, thermic Typic Ustochrepts
Yahola	Coarse-loamy, mixed (calcareous), thermic Typic Ustifluvents

* The soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series.

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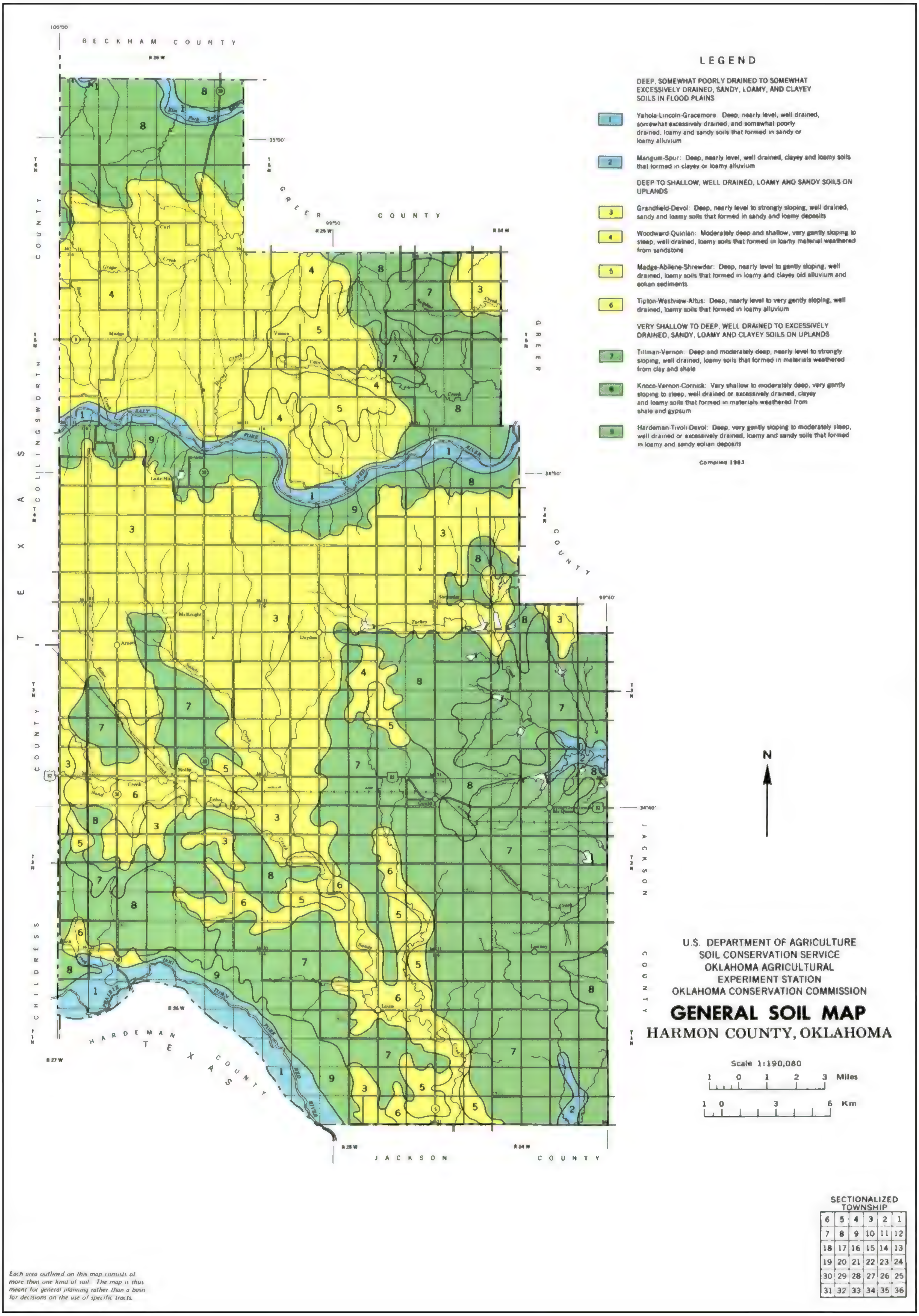
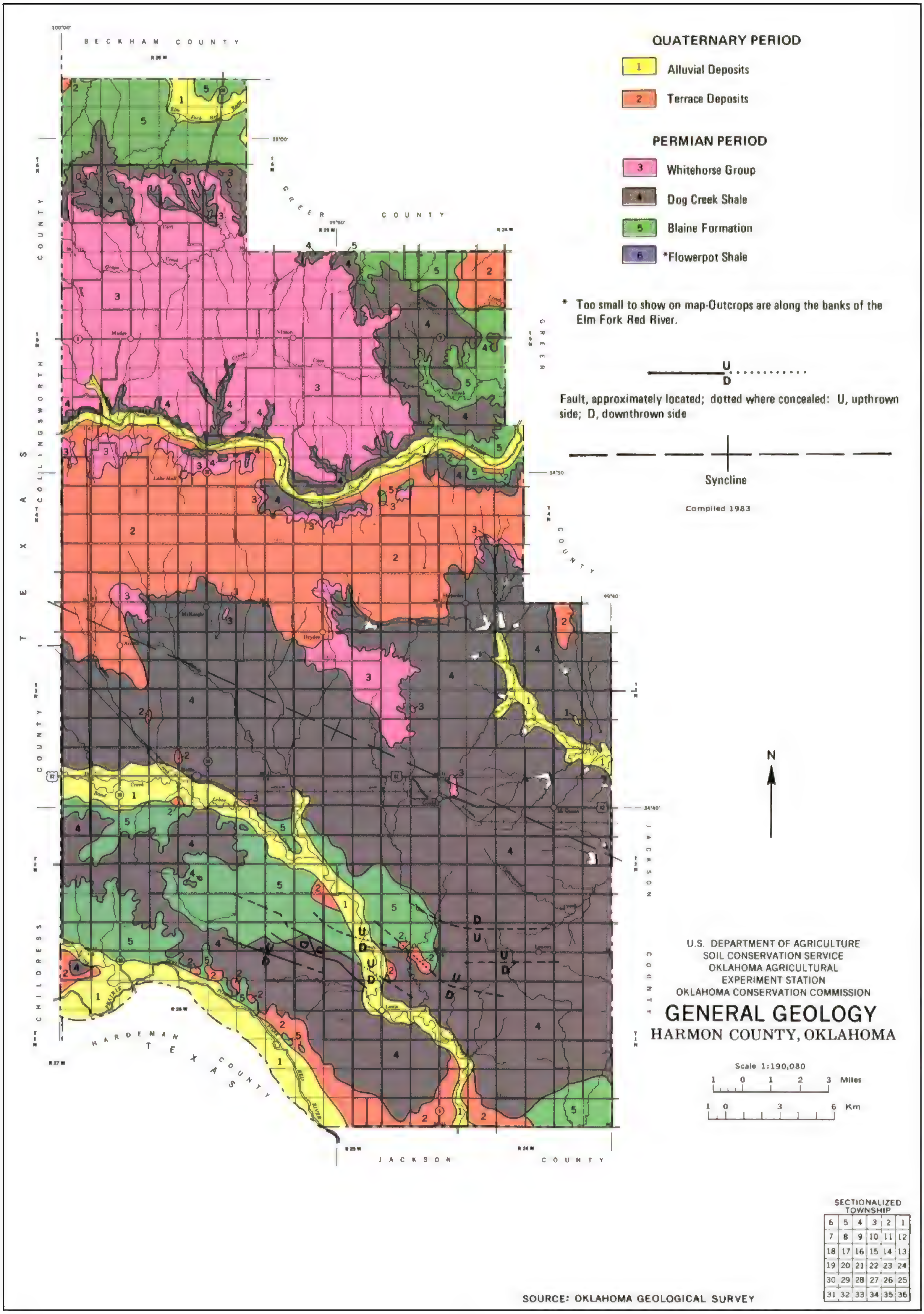
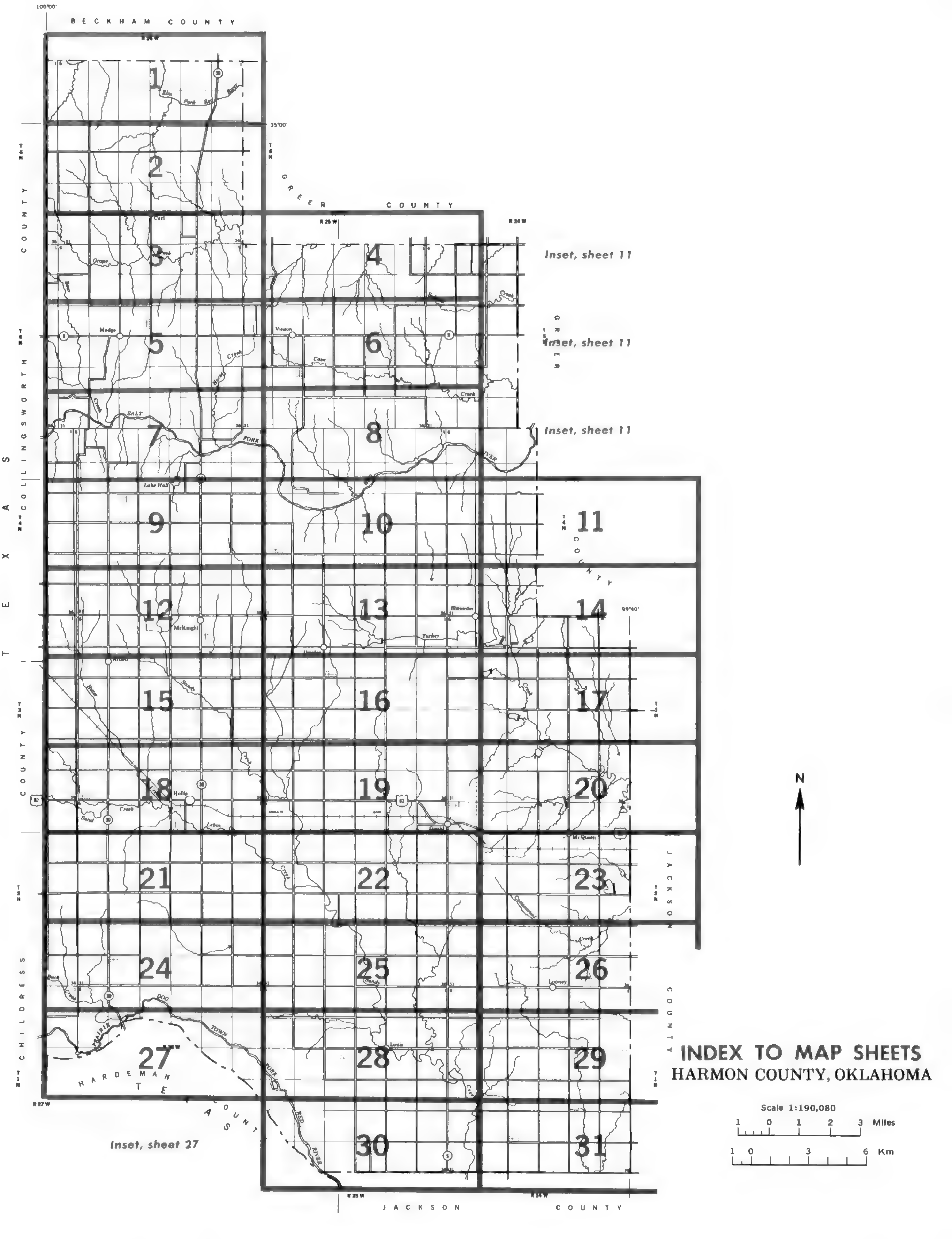


LEGEND
DEEP, SOMEWHAT POORLY DRAINED TO SOMEWHAT EXCESSIVELY DRAINED, SANDY, LOAMY, AND CLAYEY SOILS IN FLOOD PLAINS
1 Yahola-Lincoln-Gracemore: Deep, nearly level, well drained, somewhat excessively drained, and somewhat poorly drained, loamy and sandy soils that formed in sandy or loamy alluvium
2 Mangum-Spur: Deep, nearly level, well drained, clayey and loamy soils that formed in clayey or loamy alluvium
DEEP TO SHALLOW, WELL DRAINED, LOAMY AND SANDY SOILS ON UPLANDS
3 Grandfield-Devol: Deep, nearly level to strongly sloping, well drained, sandy and loamy soils that formed in sandy and loamy deposits
4 Woodward-Quinlan: Moderately deep and shallow, very gently sloping to steep, well drained, loamy soils that formed in loamy material weathered from sandstone
5 Madge-Abilene-Shrewder: Deep, nearly level to gently sloping, well drained, loamy soils that formed in loamy and clayey old alluvium and eolian sediments
6 Tipton-Westview-Altus: Deep, nearly level to very gently sloping, well drained, loamy soils that formed in loamy alluvium
VERY SHALLOW TO DEEP, WELL DRAINED TO EXCESSIVELY DRAINED, SANDY, LOAMY AND CLAYEY SOILS ON UPLANDS
7 Tillman-Vernon: Deep and moderately deep, nearly level to strongly sloping, well drained, loamy soils that formed in materials weathered from clay and shale
8 Knoco-Vernon-Cornick: Very shallow to moderately deep, very gently sloping to steep, well drained or excessively drained, clayey and loamy soils that formed in materials weathered from shale and gypsum
9 Hardeman-Tivoli-Devol: Deep, very gently sloping to moderately steep, well drained or excessively drained, loamy and sandy soils that formed in loamy and sandy eolian deposits
Compiled 1983
BECKHAM COUNTY
GREER COUNTY
TEXAS
COLLINGSWORTH COUNTY
CHILDRESS COUNTY
HARDEMAN COUNTY
JACKSON COUNTY
Carl
Madge
Vinson
McKnight
Arnett
Dryden
Hollis
Gould
McQueen
Louis
Lake Hall
Salt Fork
Red River
Prairie Dog Town Fork Red River
N
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
OKLAHOMA AGRICULTURAL EXPERIMENT STATION
OKLAHOMA CONSERVATION COMMISSION
GENERAL SOIL MAP
HARMON COUNTY, OKLAHOMA
Scale 1:190,080
1 0 1 2 3 Miles
1 0 3 6 Km
SECTIONALIZED TOWNSHIP
6 5 4 3 2 1
7 8 9 10 11 12
18 17 16 15 14 13
19 20 21 22 23 24
30 29 28 27 26 25
31 32 33 34 35 36
Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.


QUATERNARY PERIOD
1 Alluvial Deposits
2 Terrace Deposits
PERMIAN PERIOD
3 Whitehorse Group
4 Dog Creek Shale
5 Blaine Formation
6 *Flowerpot Shale
* Too small to show on map-Outcrops are along the banks of the Elm Fork Red River.
U
D
Fault, approximately located; dotted where concealed: U, upthrown side; D, downthrown side
Syncline
Compiled 1983
BECKHAM COUNTY
GREER COUNTY
GREER
COUNTY
JACKSON COUNTY
JACKSON COUNTY
HARDEMAN COUNTY
TEXAS
COLLINGSWORTH COUNTY
CHILDRESS COUNTY
TEXAS
N
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
OKLAHOMA AGRICULTURAL
EXPERIMENT STATION
OKLAHOMA CONSERVATION COMMISSION
GENERAL GEOLOGY
HARMON COUNTY, OKLAHOMA
Scale 1:190,080
1 0 1 2 3 Miles
1 0 3 6 Km
SECTIONALIZED TOWNSHIP
6 5 4 3 2 1
7 8 9 10 11 12
18 17 16 15 14 13
19 20 21 22 23 24
30 29 28 27 26 25
31 32 33 34 35 36
SOURCE: OKLAHOMA GEOLOGICAL SURVEY



Original text from each individual map sheet read:
This map was compiled by the U.S. Department of Agriculture, Soil Conservation Service, and cooperating agencies on 1977 orthophotography obtained from the U.S. Department of Interior Geological Survey.

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

The legend is numeric. Soils without a slope designation in the name are those that occur only on level or nearly level landscapes of occasionally or frequently flooded flood plains, dune landscapes of sandy uplands, soils classified at the Great group level, or miscellaneous areas.

SYMBOL	NAME
1	Abilene loam, 0 to 1 percent slopes
2	Abilene loam, 1 to 3 percent slopes
3	Acme-Vinson complex, 0 to 1 percent slopes
4	Acme-Vinson complex, 1 to 3 percent slopes
5	Altus fine sandy loam, 0 to 1 percent slopes
6	Altus fine sandy loam, 1 to 3 percent slopes
7	Aspermont silt loam, 1 to 3 percent slopes
8	Aspermont silt loam, 3 to 5 percent slopes
9	Aspermont silt loam, 5 to 8 percent slopes
10	Beckman silty clay, occasionally flooded
11	Carey loam, 1 to 3 percent slopes
12	Clairemont silt loam, occasionally flooded
13	Cornick-Vinson-Rock outcrop complex, 1 to 5 percent slopes
14	Devol loamy fine sand, 0 to 3 percent slopes
15	Devol loamy fine sand, 3 to 8 percent slopes
16	Devol loamy fine sand, 3 to 8 percent slopes, eroded
17	Devol fine sandy loam, 1 to 3 percent slopes
18	Gracemont fine sandy loam, saline, frequently flooded
19	Gracemore loam, saline, frequently flooded
20	Grandfield loamy fine sand, 0 to 3 percent slopes
21	Grandfield loamy fine sand, 2 to 5 percent slopes, eroded
22	Grandfield fine sandy loam, 0 to 2 percent slopes
23	Grandfield fine sandy loam, 2 to 5 percent slopes, eroded
24	Grandmore loamy fine sand, 0 to 3 percent slopes
25	Hardeman fine sandy loam, 1 to 3 percent slopes
26	Hardeman fine sandy loam, 3 to 5 percent slopes
27	Hardeman fine sandy loam, 5 to 8 percent slopes
28	Hardeman fine sandy loam, 5 to 12 percent slopes, eroded
29	Hardeman fine sandy loam, 8 to 12 percent slopes
30	Hardeman-Likes-Devol complex, 3 to 20 percent slopes
31	Hollister silty clay loam, 0 to 1 percent slopes
32	Knoco-Aspermont complex, 3 to 12 percent slopes, gullied
33	Knoco-Badland association, gently sloping
34	Knoco-Cornick-Rock outcrop complex, 2 to 20 percent slopes
35	Knoco-Rock outcrop complex, 20 to 40 percent slopes
36	Likes fine sand, hummocky
37	Lincoln loamy fine sand, frequently flooded
38	Madge loam, 0 to 1 percent slopes
39	Madge loam, 1 to 3 percent slopes
40	Mangum silty clay loam, occasionally flooded
41	Mangum silty clay, rarely flooded
42	McKnight loamy fine sand, 0 to 3 percent slopes
43	McKnight loamy fine sand, 2 to 5 percent slopes, eroded
44	McKnight fine sandy loam, 1 to 3 percent slopes
45	Nobscot fine sand, 2 to 5 percent slopes
46	Nobscot fine sand, 5 to 12 percent slopes
47	Quanah-Talpa complex, 1 to 5 percent slopes
48	Quinlan-Rock outcrop complex, 12 to 45 percent slopes
49	Quinlan-Woodward complex, 3 to 5 percent slopes, eroded
50	Salt flats
51	Shrewder fine sandy loam, 1 to 3 percent slopes
52	Shrewder fine sandy loam, 3 to 5 percent slopes
53	Spur clay loam, occasionally flooded
54	Spur clay loam, frequently flooded
55	Tillman clay loam, 0 to 1 percent slopes
56	Tillman clay loam, 1 to 3 percent slopes
57	Tipton loam, 0 to 1 percent slopes
58	Tipton loam, 1 to 3 percent slopes
59	Tivoli fine sand
60	Likes-Devol complex, 3 to 12 percent slopes, gullied
61	Ustorthents, sandy
62	Vernon clay loam, 1 to 3 percent slopes
63	Vernon clay loam, 3 to 5 percent slopes
64	Vernon clay loam, 2 to 5 percent slopes, eroded
65	Vernon-Knoco complex, 1 to 12 percent slopes
66	Westview silty clay loam, 0 to 1 percent slopes
67	Woodward loam, 1 to 3 percent slopes
68	Woodward loam, 3 to 5 percent slopes
69	Woodward-Quinlan complex, 1 to 3 percent slopes
70	Woodward-Quinlan complex, 3 to 5 percent slopes
71	Woodward-Quinlan complex, 5 to 12 percent slopes
72	Yahola fine sandy loam, rarely flooded
73	Yahola fine sandy loam, occasionally flooded

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label) — Hadley Airstrip

- Small airport, airfield, park, oilfield, cemetery, or flood pool — FLOOD POOL LINE

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate — 21
- Federal — 173
- State — 28
- County, farm or ranch — 1283

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small — water, w

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — Gas
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water, w
- Intermittent — int, i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — 34, 47

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

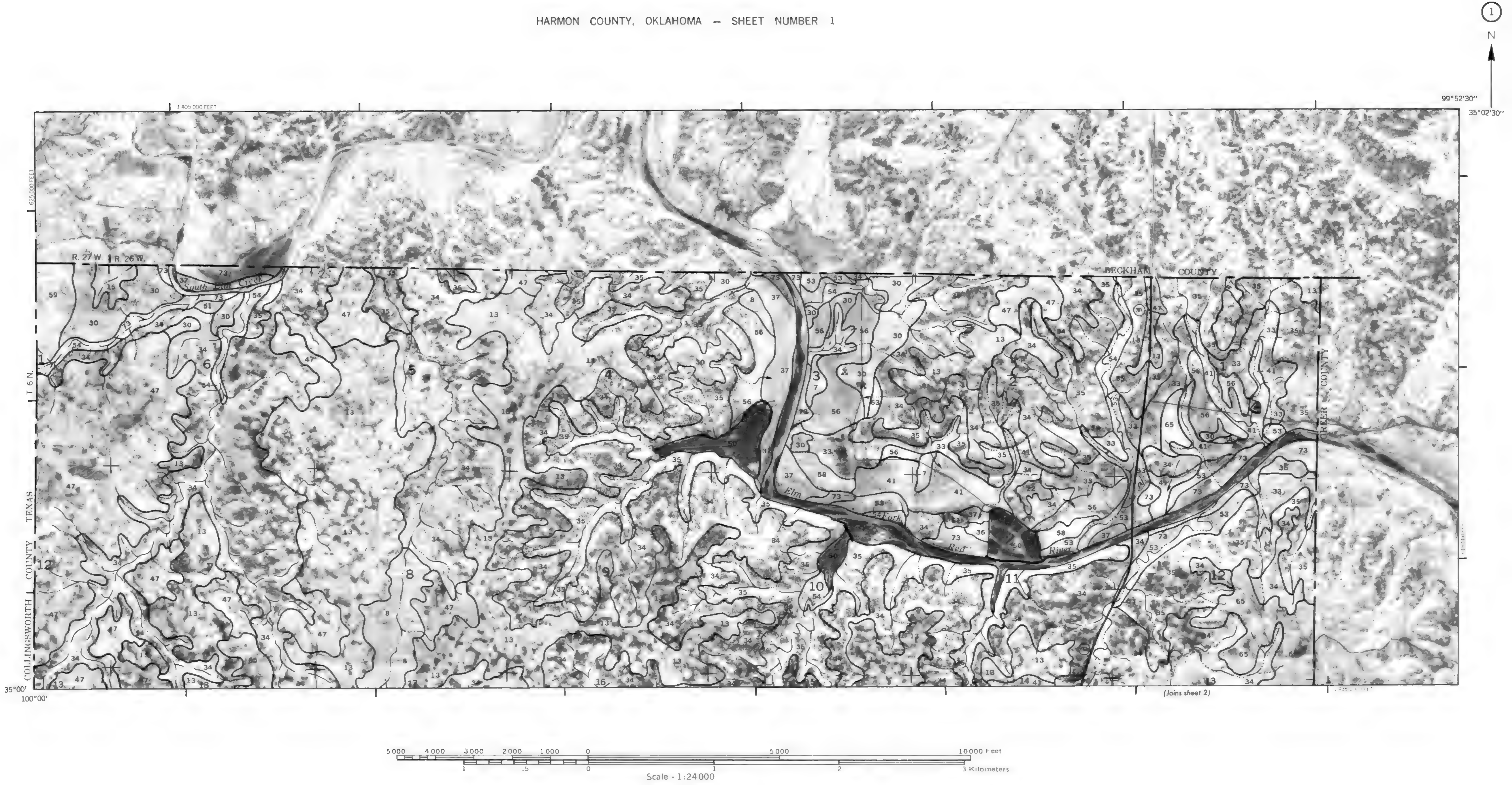
GYP SINK

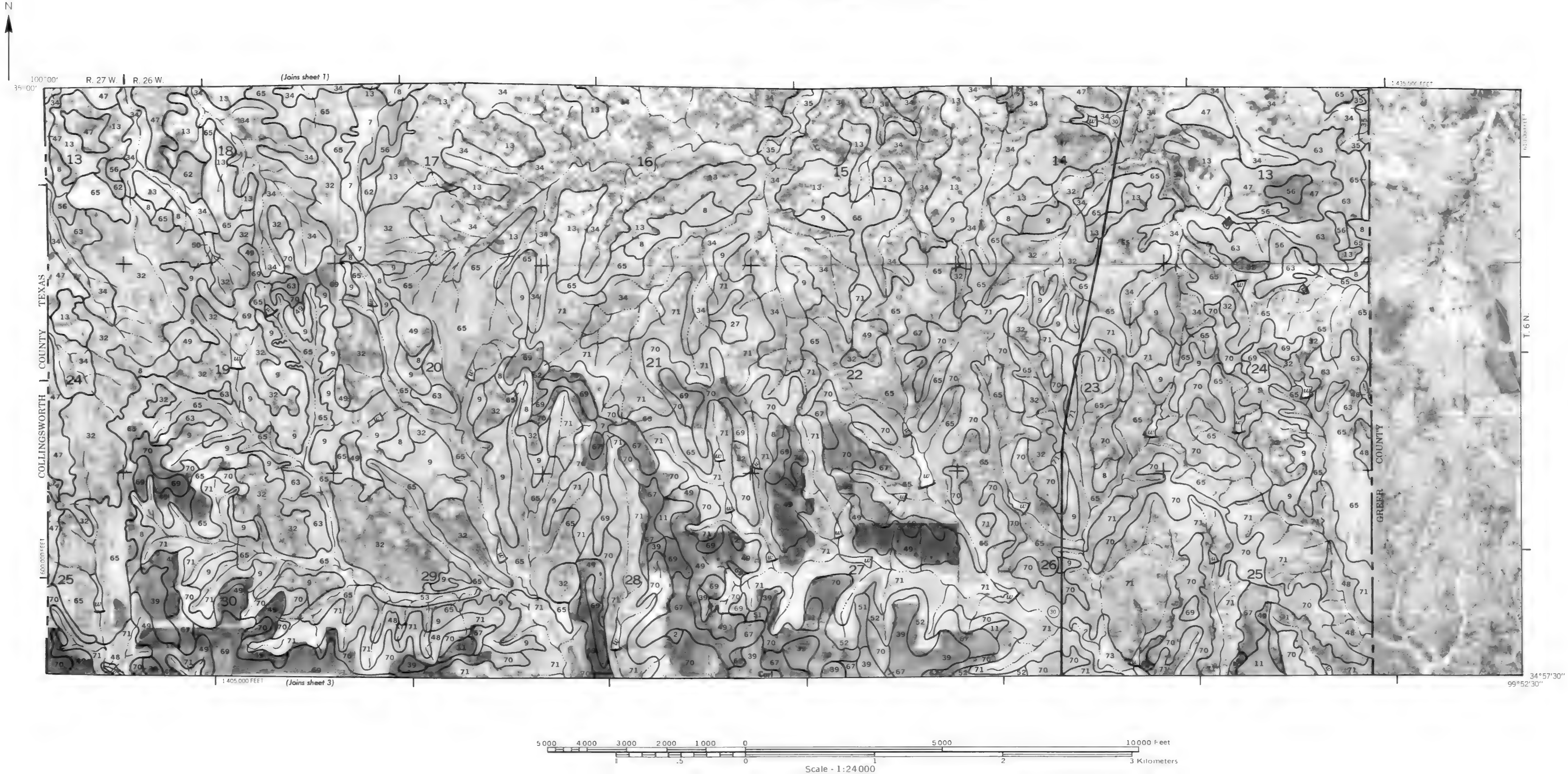
SOIL SAMPLE SITE (normally not shown)

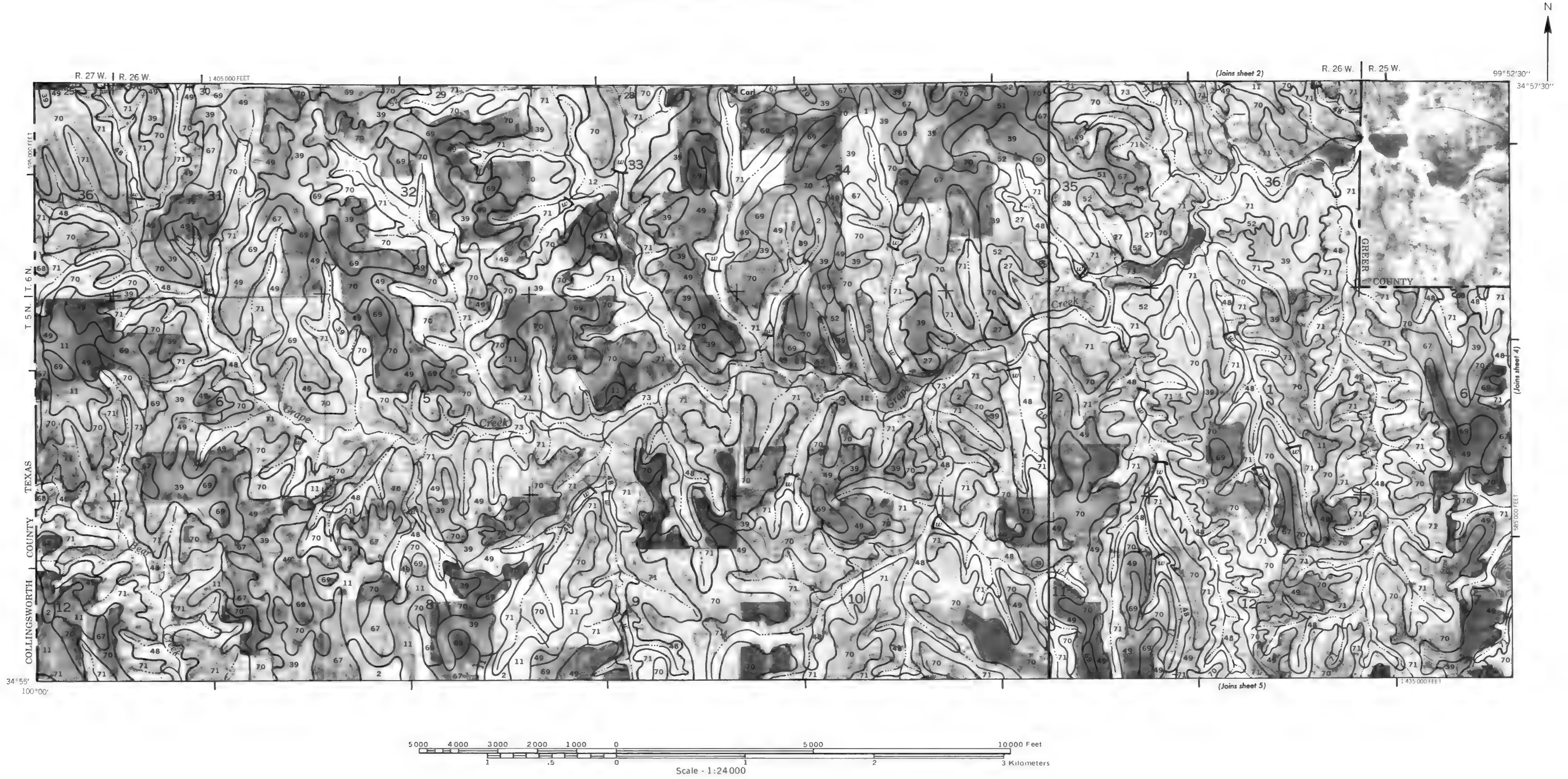
MISCELLANEOUS

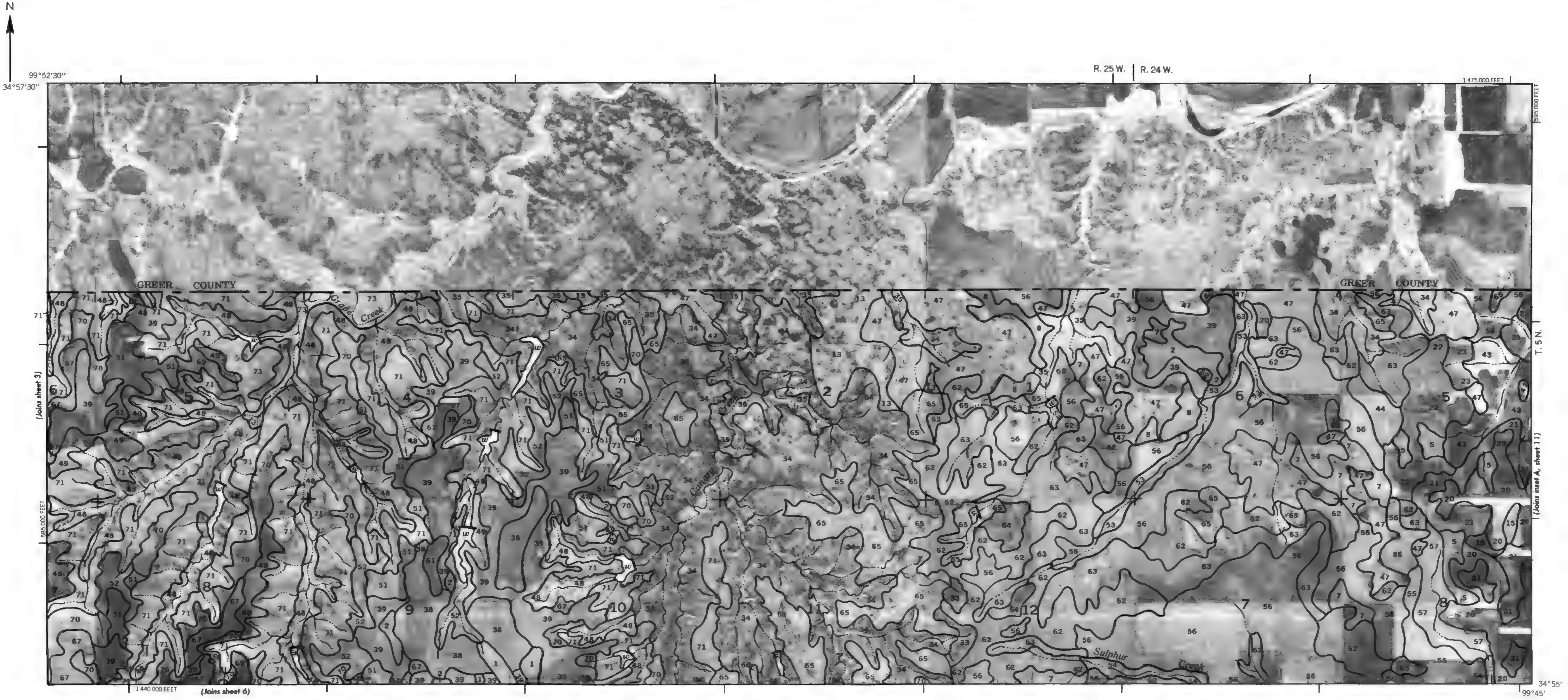
- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot

HARMON COUNTY, OKLAHOMA — SHEET NUMBER 1




(Joins sheet 1)
R. 27 W.
R. 26 W.
TEXAS
COLLINGSWORTH
COUNTY
GREER
COUNTY
T. 6 N.
(Joins sheet 3)
34°57'30"
99°52'30"
5000 4000 3000 2000 1000 0 5000 10000 Feet
1 .5 0 1 2 3 Kilometers
Scale - 1:24000


3
N
R. 27 W.
R. 26 W.
1 405 000 FEET
(Joins sheet 2)
R. 26 W.
R. 25 W.
99°52'30"
34°57'30"
T. 6 N.
T. 5 N.
TEXAS
COLLINGSWORTH COUNTY
GREER COUNTY
Carl
Grape Creek
Bear
(Joins sheet 4)
(Joins sheet 5)
1 435 000 FEET
34°55'
100°00'
5000
4000
3000
2000
1000
0
5000
10000 Feet
1
.5
0
1
2
3 Kilometers
Scale - 1:24000

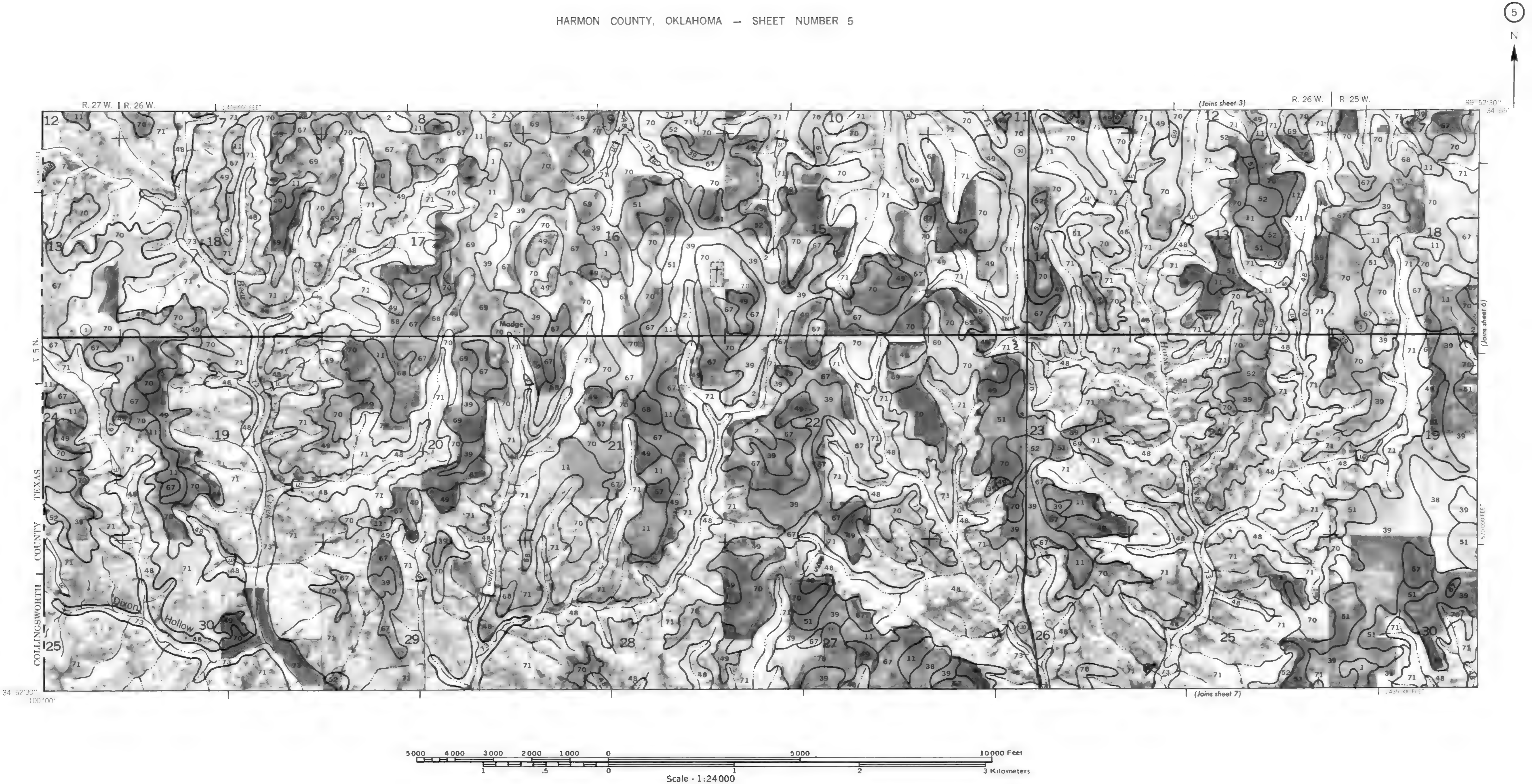


5000 4000 3000 2000 1000 0 5000 10000 Feet

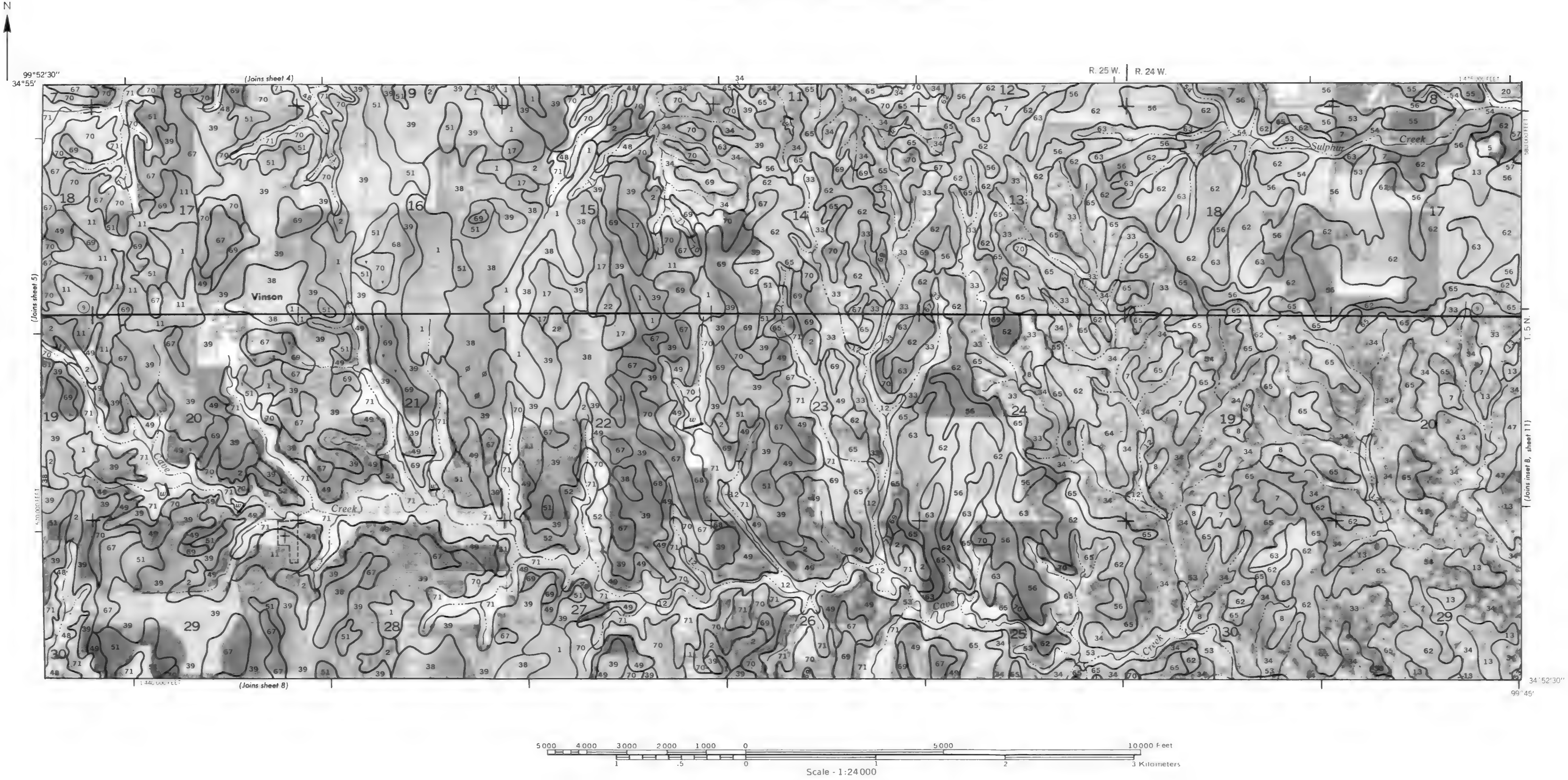
1 .5 0 1 2 3 Kilometers

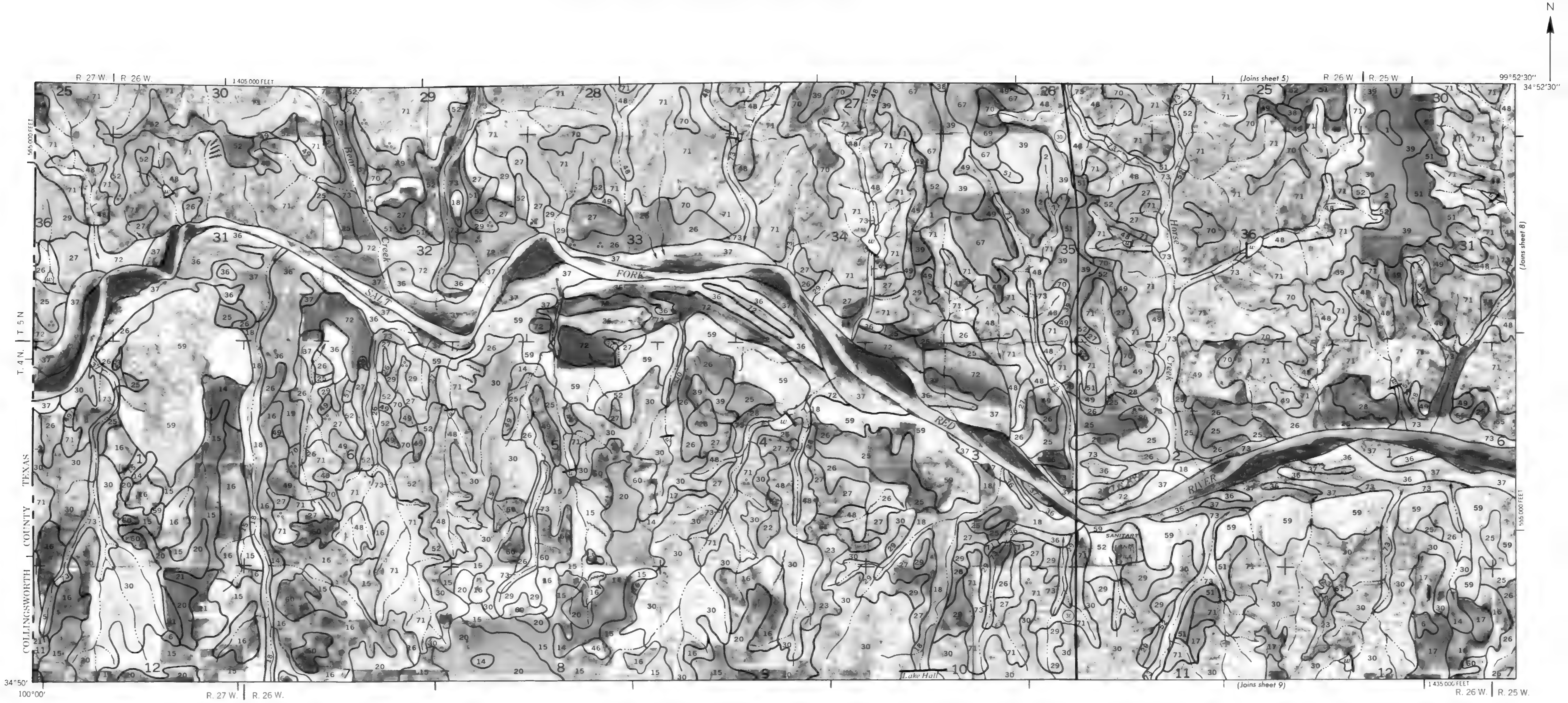
Scale - 1:24000

HARMON COUNTY, OKLAHOMA — SHEET NUMBER 5



HARMON COUNTY, OKLAHOMA — SHEET NUMBER 6





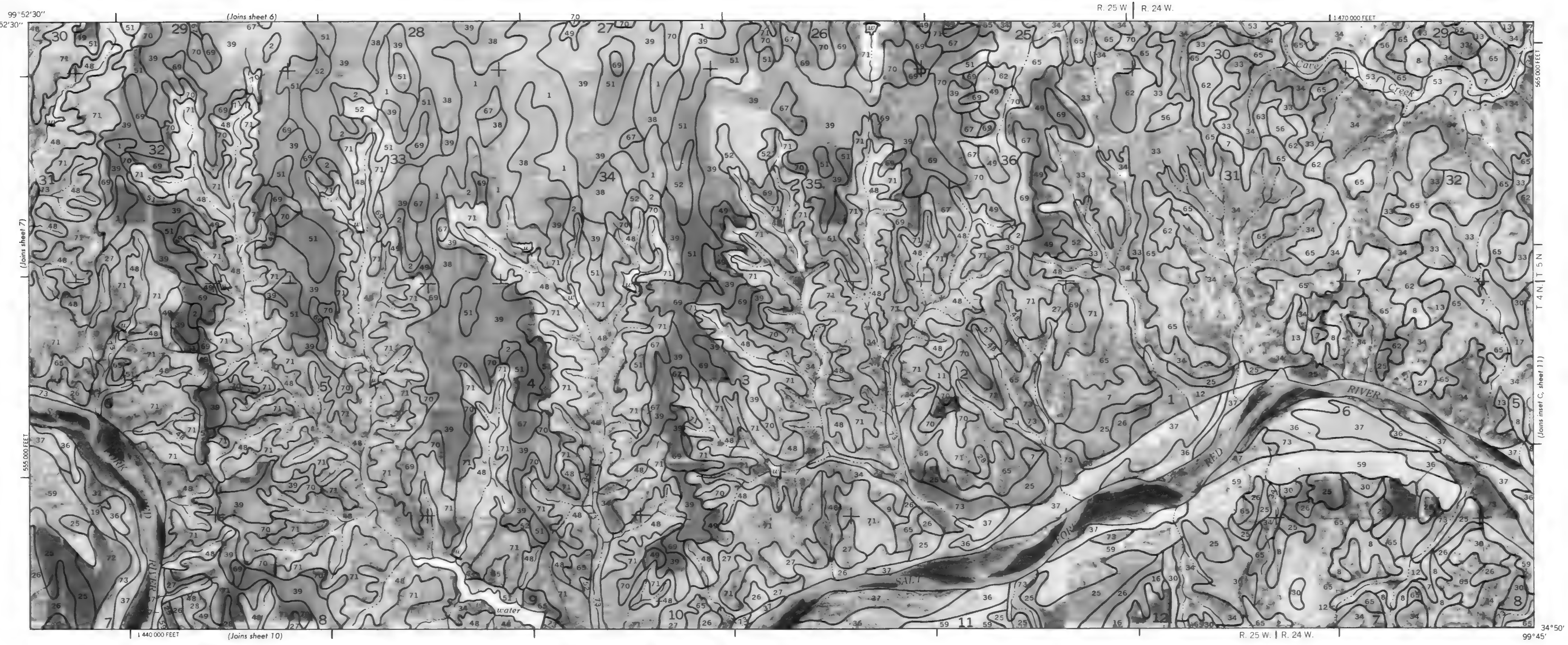
5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24000

N

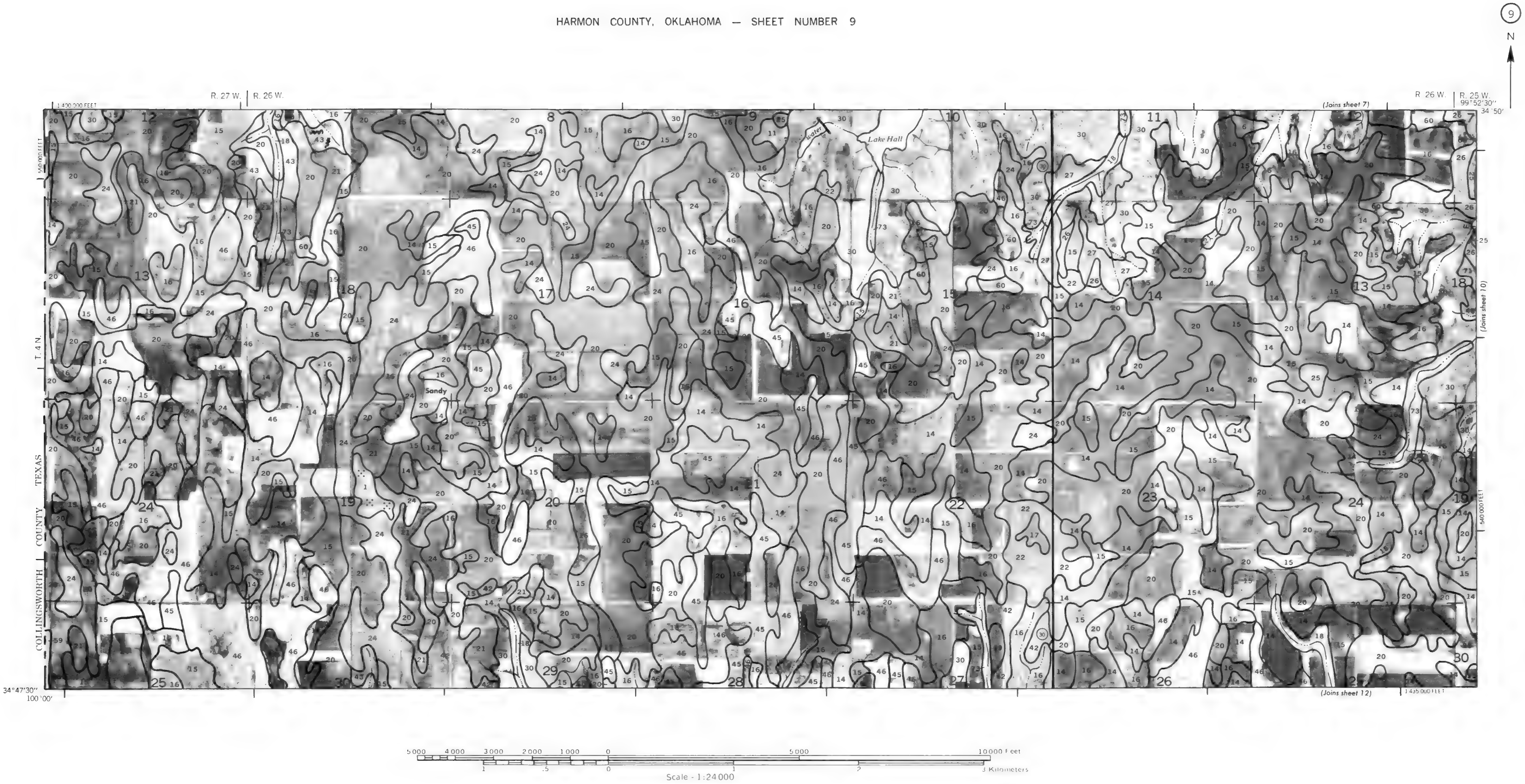
HARMON COUNTY, OKLAHOMA — SHEET NUMBER 8



5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24 000


9
N
R. 27 W. | R. 26 W.
R. 26 W. | R. 25 W.
99°52'30"
34°50'
(Joins sheet 7)
(Joins sheet 10)
(Joins sheet 12)
Lake Hall
Water
Sandy
T. 4 N.
COLLINGSWORTH COUNTY, TEXAS
34°47'30"
100°00'
1 400 000 FEET
1 435 000 FEET
540 000 FEET
5000 4000 3000 2000 1000 0 5000 10 000 Feet
1 .5 0 1 2 3 Kilometers
Scale - 1:24 000

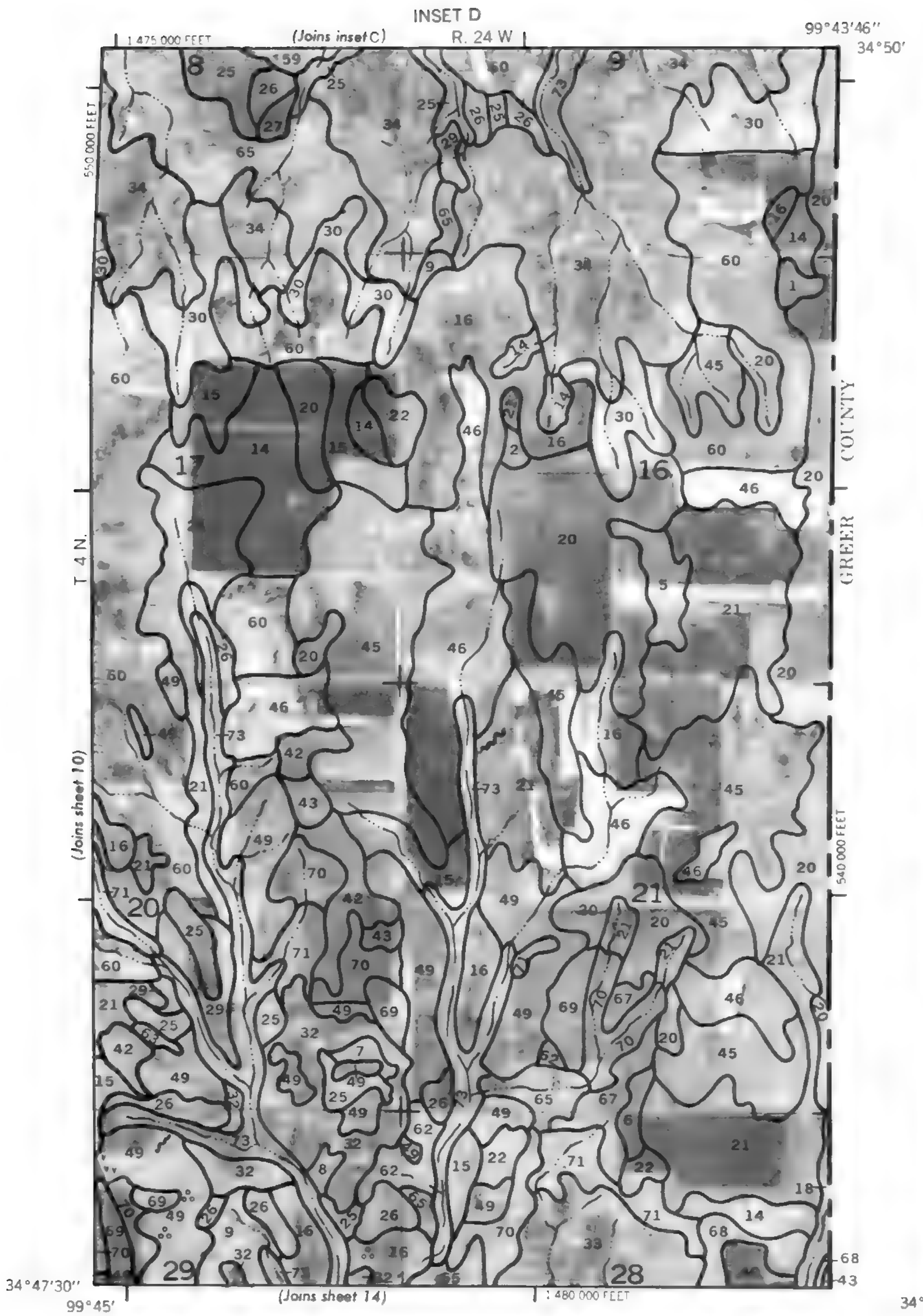
HARMON COUNTY, OKLAHOMA — SHEET NUMBER 10

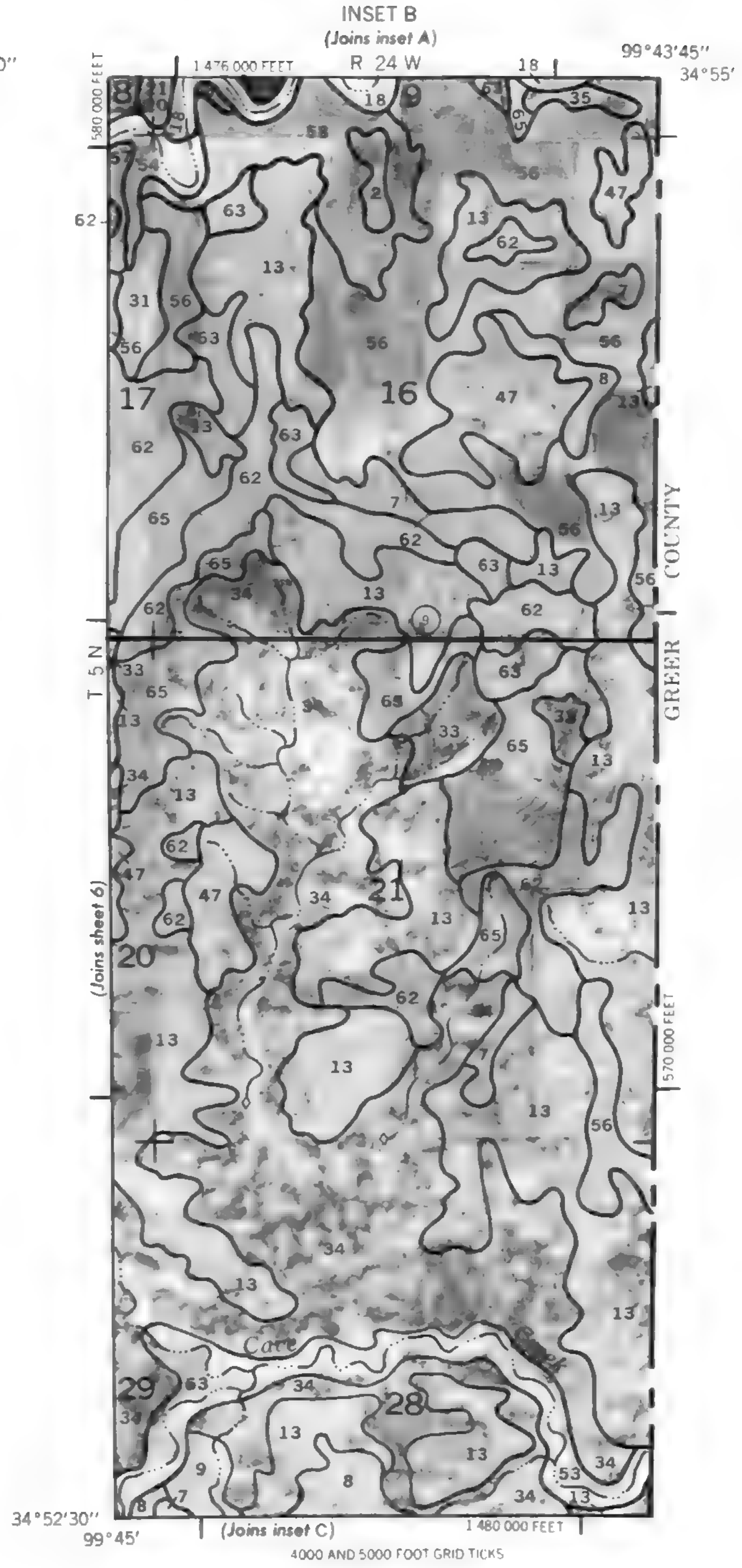
N

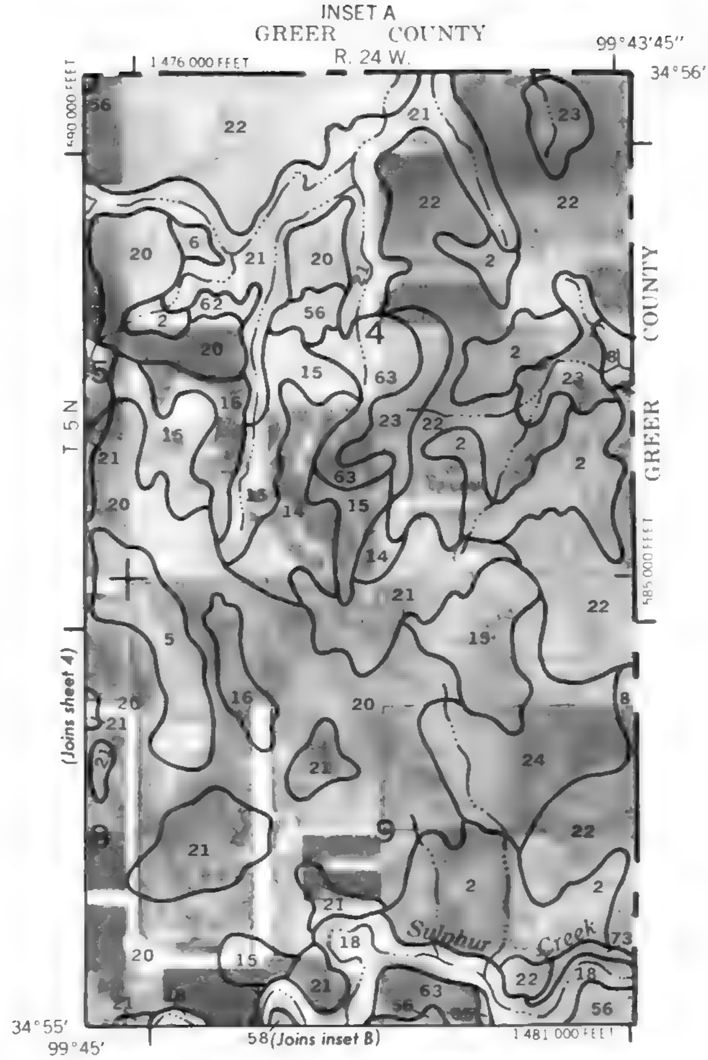
5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

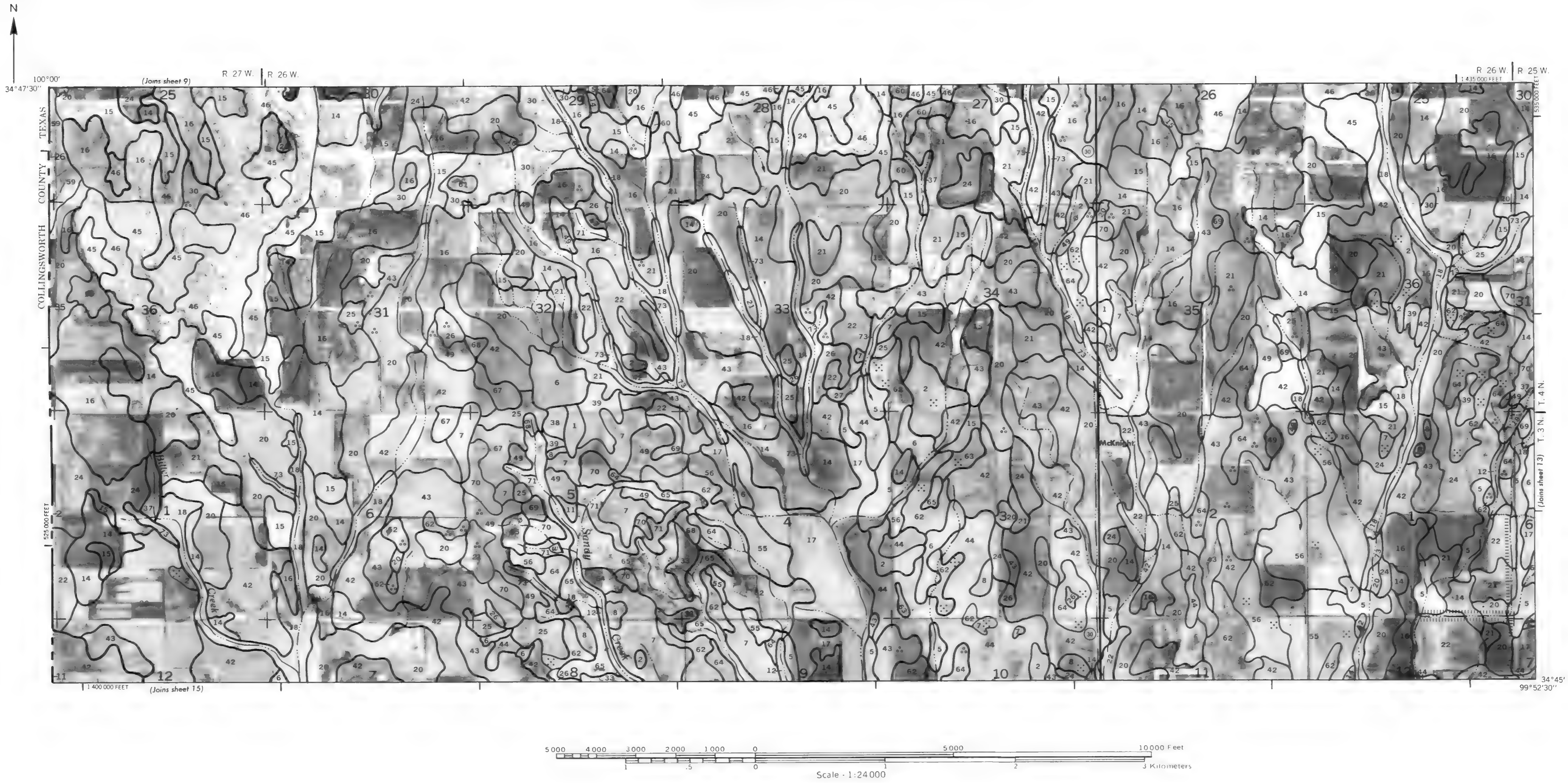
Scale - 1:24000

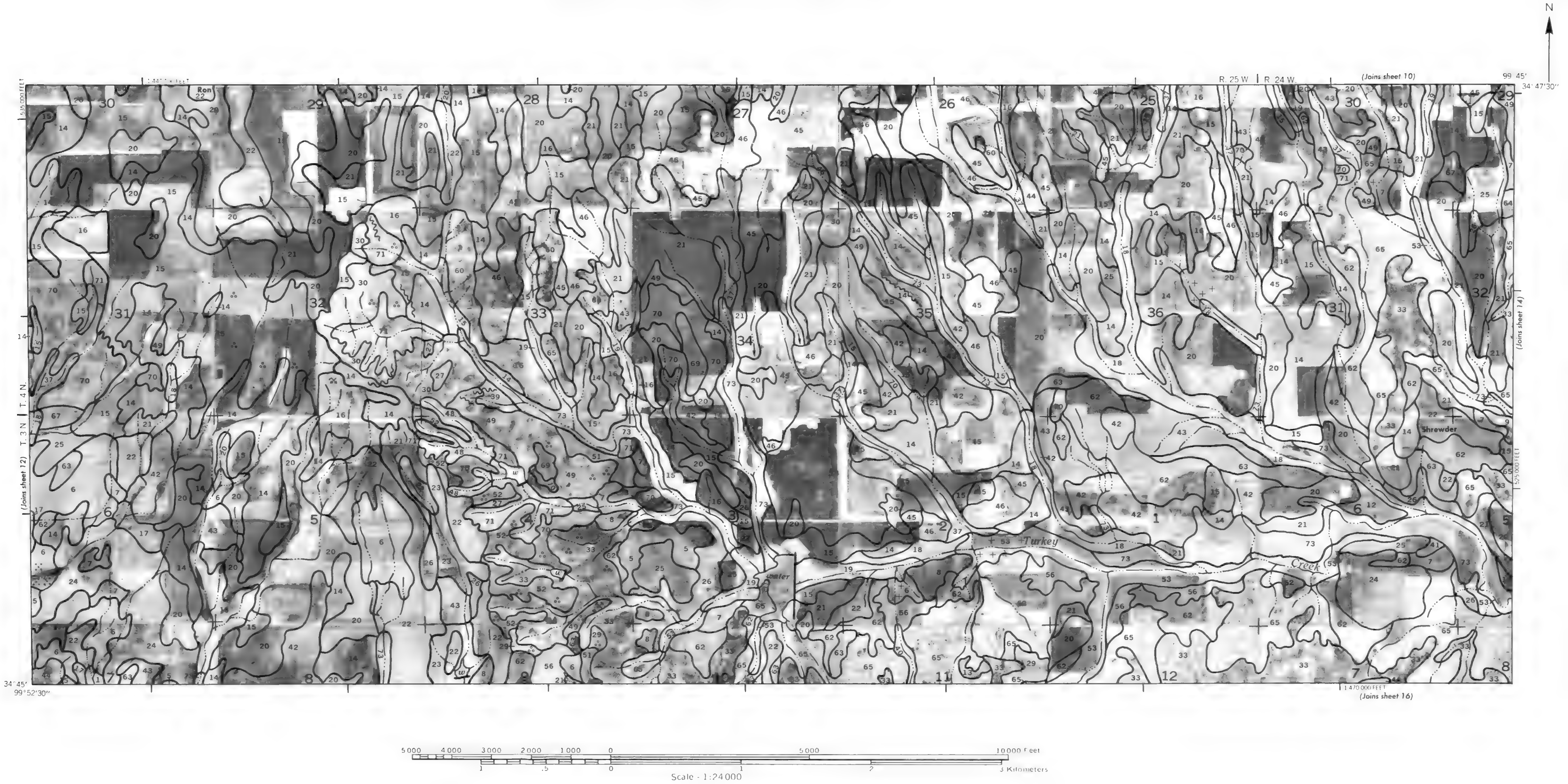




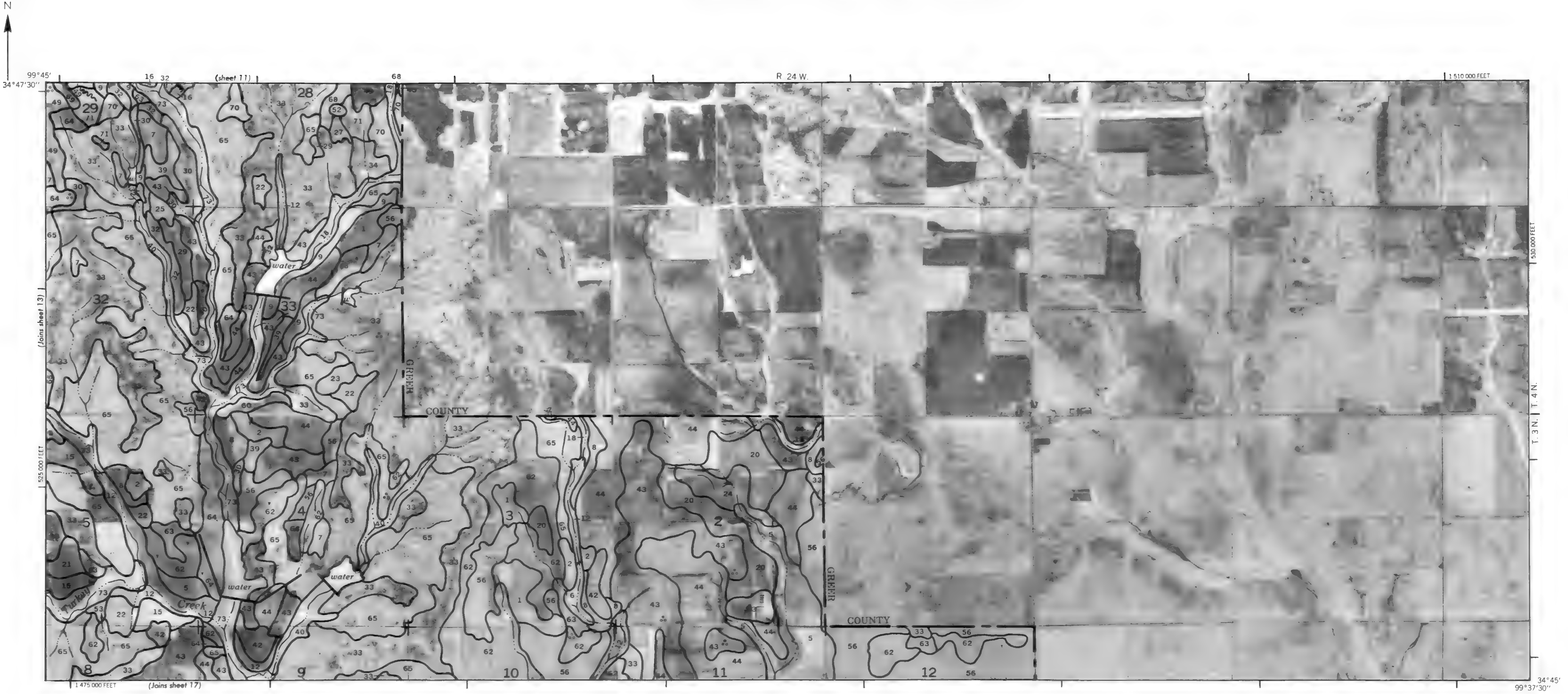


Scale - 1:24 000


N
R 27 W.
R 26 W.
R 25 W.
(Joins sheet 9)
(Joins sheet 15)
(Joins sheet 13)
100°00'
34°47'30"
34°45'
99°52'30"
COLLINGSWORTH COUNTY TEXAS
T. 4 N.
T. 3 N.
1 435 000 FEET
535 000 FEET
525 000 FEET
1 400 000 FEET
McKnight
Sandy Creek
Bitter Creek
5000 4000 3000 2000 1000 0 5000 10 000 Feet
1 .5 0 1 2 3 Kilometers
Scale 1:24 000


N
(Joins sheet 10)
R. 25 W. | R. 24 W.
99°45′
34°47′30″
(Joins sheet 12)
(Joins sheet 14)
(Joins sheet 16)
T. 4 N.
T. 3 N.
34°45′
99°52′30″
1 470 000 FEET
Shrewder
Turkey
Creek
5000 4000 3000 2000 1000 0 5000 10000 Feet
1 .5 0 1 2 3 Kilometers
Scale - 1:24 000

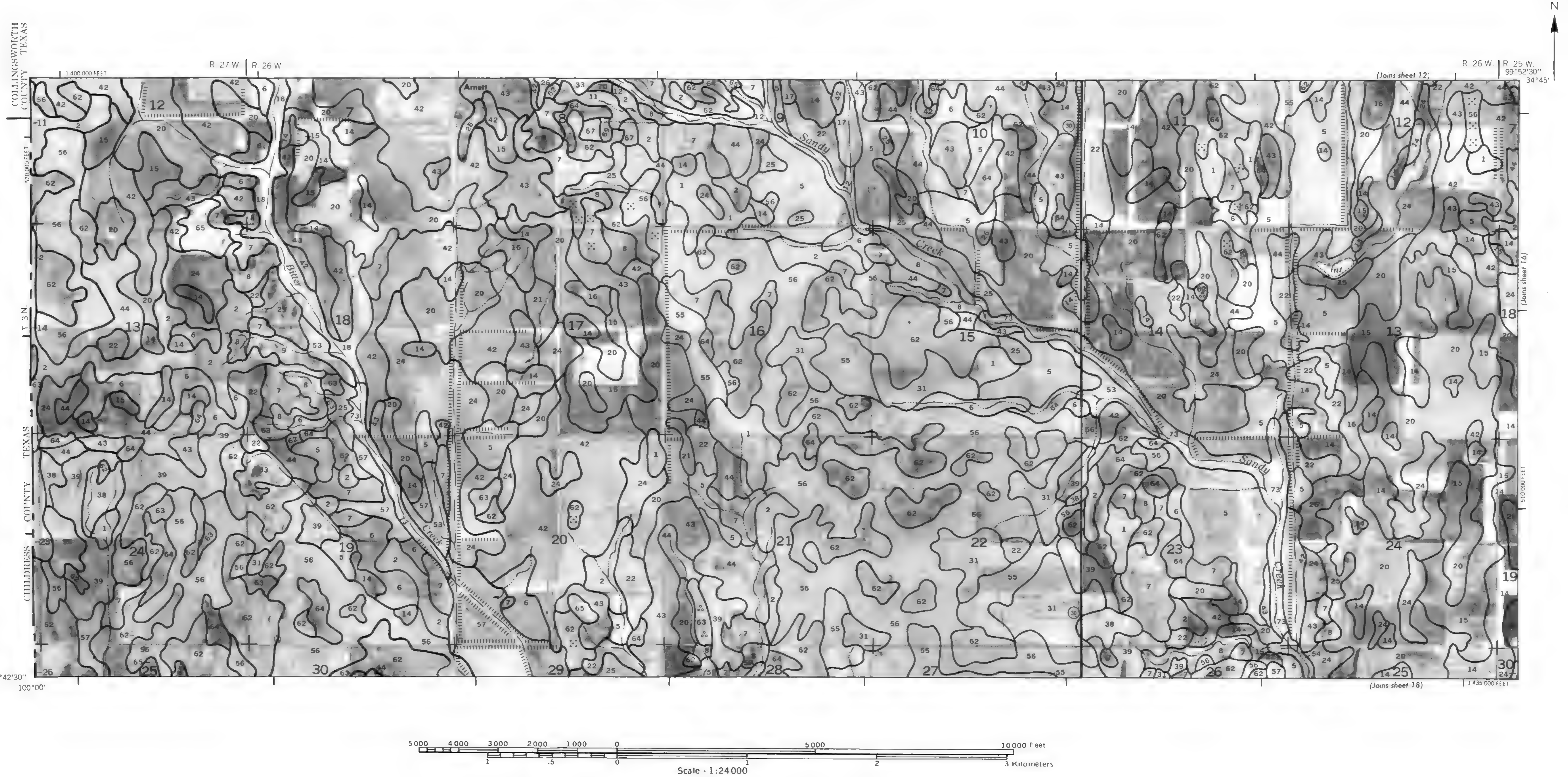
HARMON COUNTY, OKLAHOMA — SHEET NUMBER 14



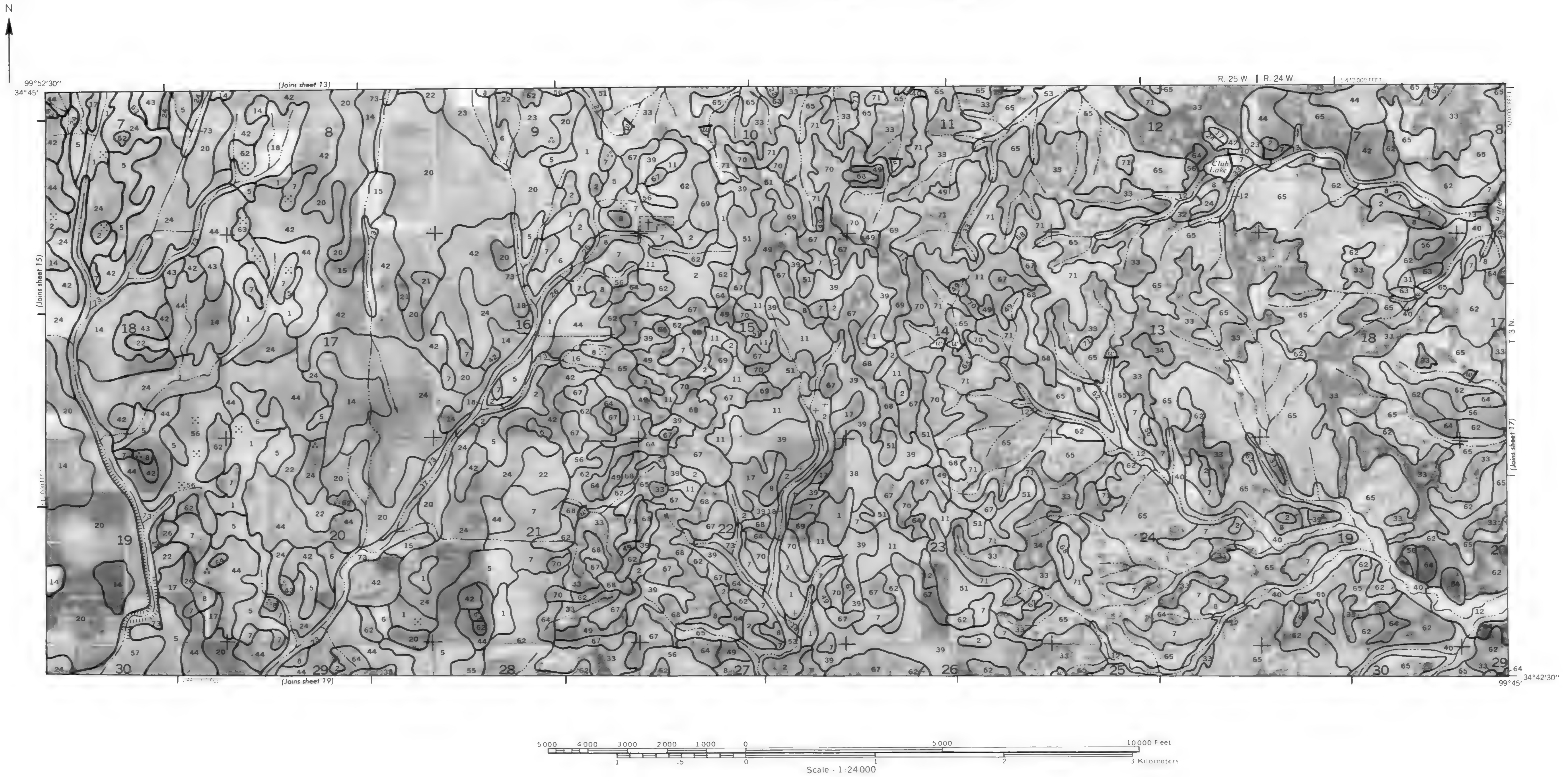
5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

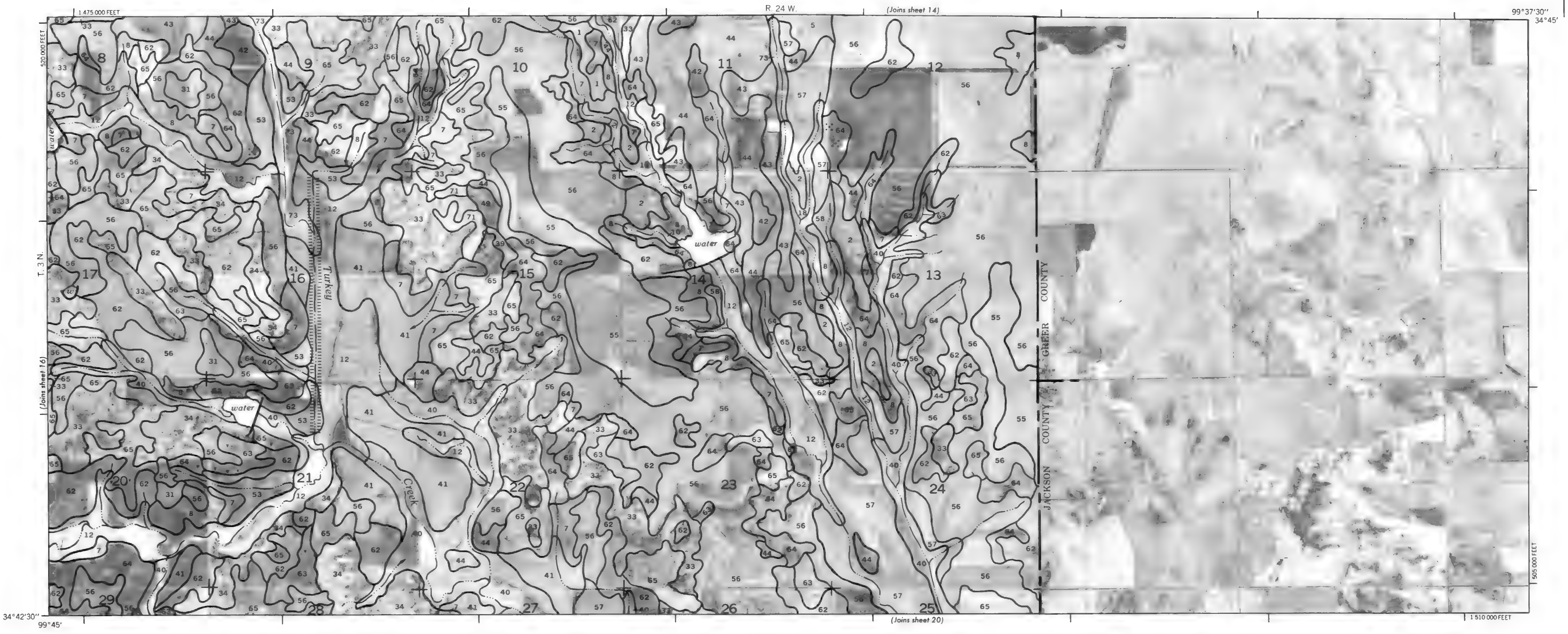
Scale - 1:24000


15
N
COLLINGSWORTH COUNTY
TEXAS
CHILDRESS COUNTY
TEXAS
R. 27 W
R. 26 W
R. 26 W.
R. 25 W.
T. 3 N.
1 400 000 FEET
520 000 FEET
510 000 FEET
1 435 000 FEET
99°52'30"
34°45'
34°42'30"
100°00'
(Joins sheet 12)
(Joins sheet 16)
(Joins sheet 18)
Arnett
Sandy Creek
Butler Creek
Creek
5000 4000 3000 2000 1000 0 5000 10000 Feet
1 .5 0 1 2 3 Kilometers
Scale - 1:24000

HARMON COUNTY, OKLAHOMA — SHEET NUMBER 16



N

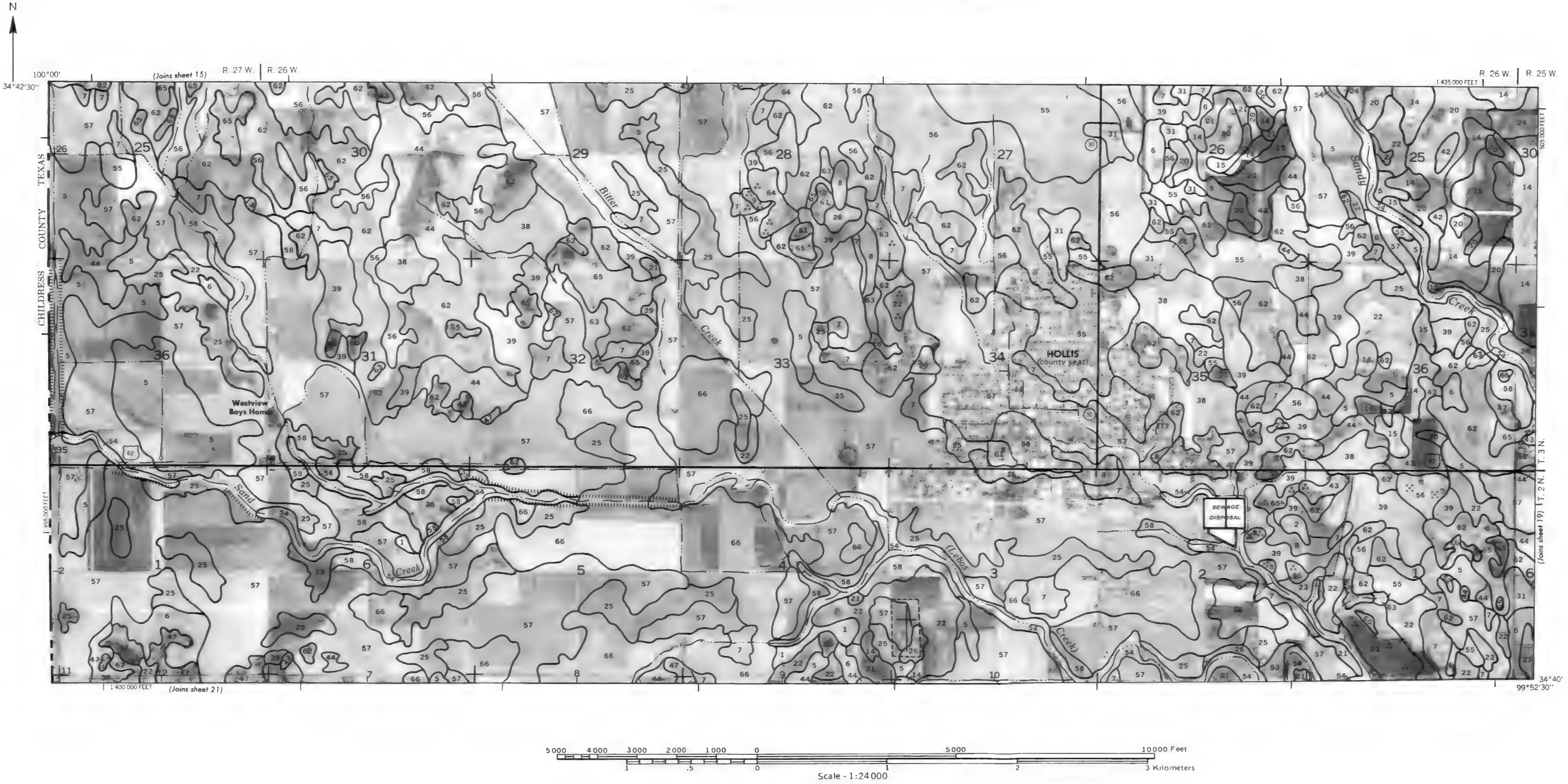


5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24 000

HARMON COUNTY, OKLAHOMA — SHEET NUMBER 18



N

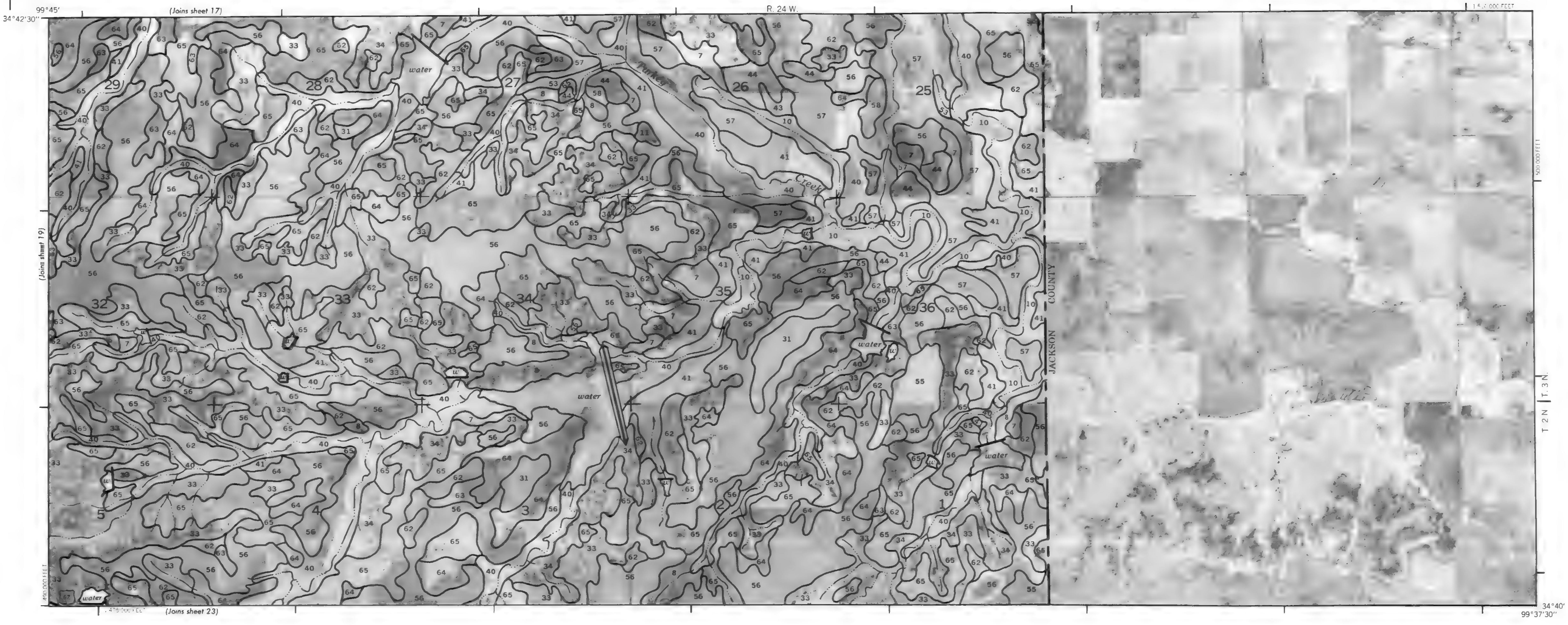
5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24 000

HARMON COUNTY, OKLAHOMA — SHEET NUMBER 20

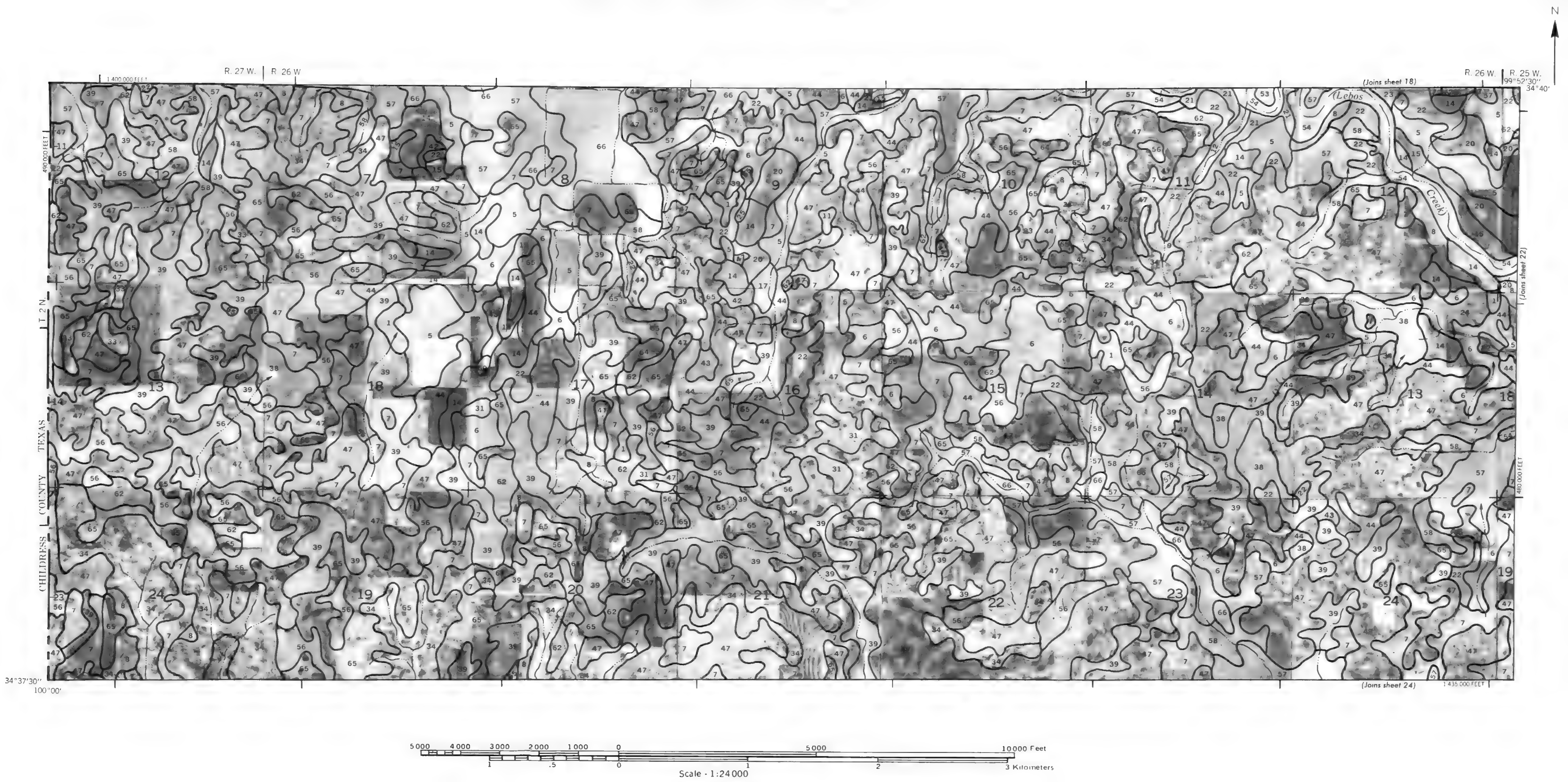
N



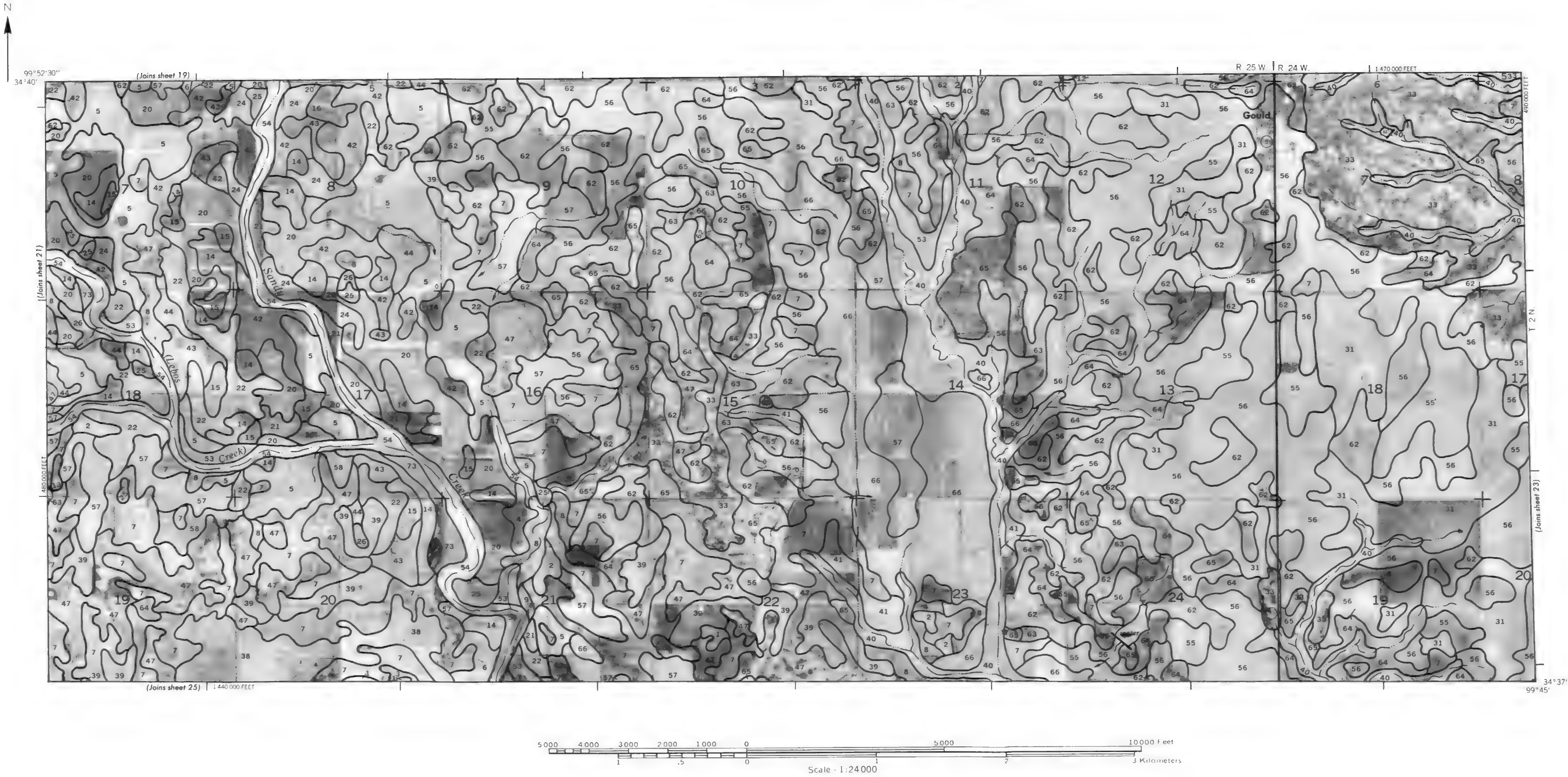
5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24 000


N
R. 27 W.
R. 26 W.
1 400 000 FEET
(Joins sheet 18)
R. 26 W.
R. 25 W.
99°52'30"
34°40'
490 000 FEET
T. 2 N.
TEXAS
CHILDRESS COUNTY
(Joins sheet 22)
480 000 FEET
Lebos Creek
34°37'30"
100°00'
(Joins sheet 24)
1 435 000 FEET
5000 4000 3000 2000 1000 0 5000 10000 Feet
1 .5 0 1 2 3 Kilometers
Scale - 1:24 000

HARMON COUNTY, OKLAHOMA — SHEET NUMBER 22



5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24000

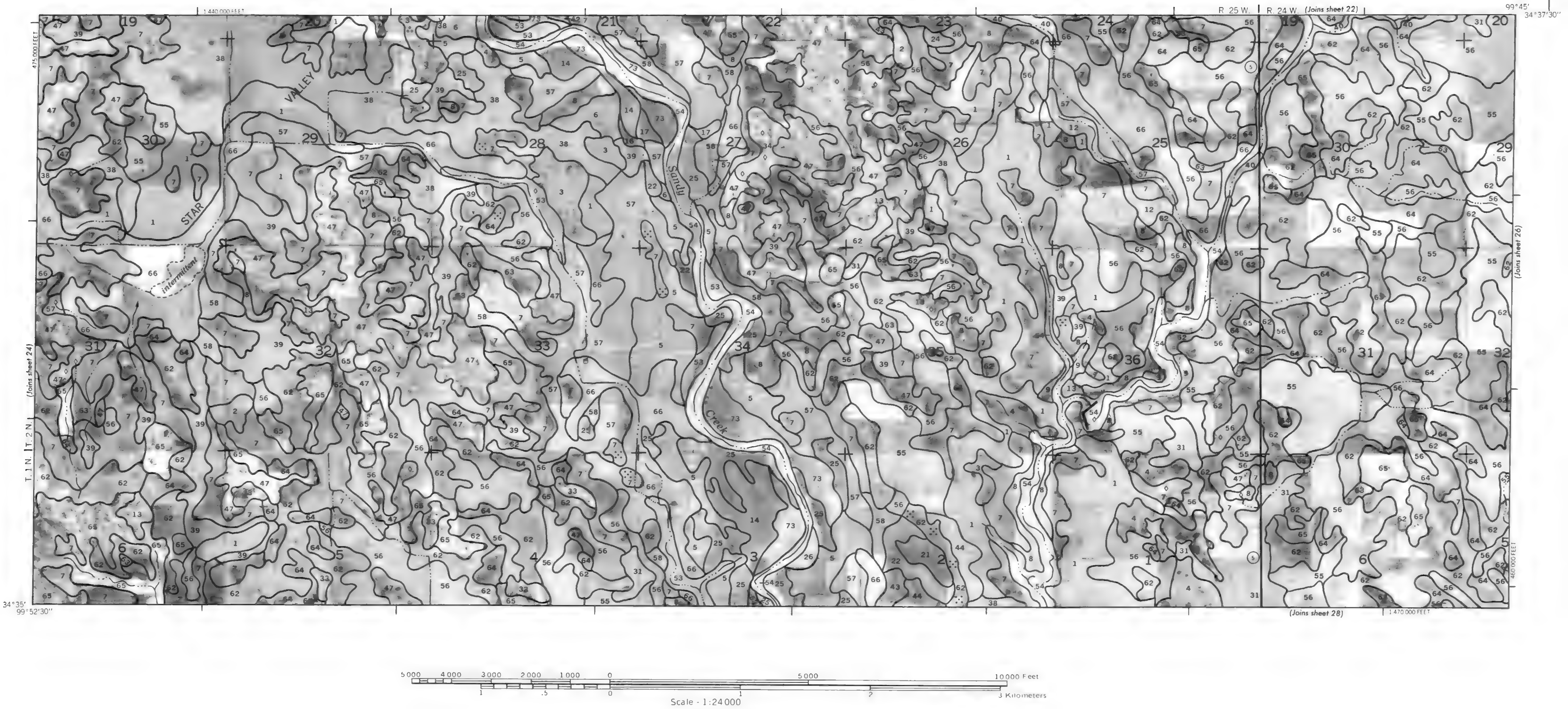
HARMON COUNTY, OKLAHOMA — SHEET NUMBER 24

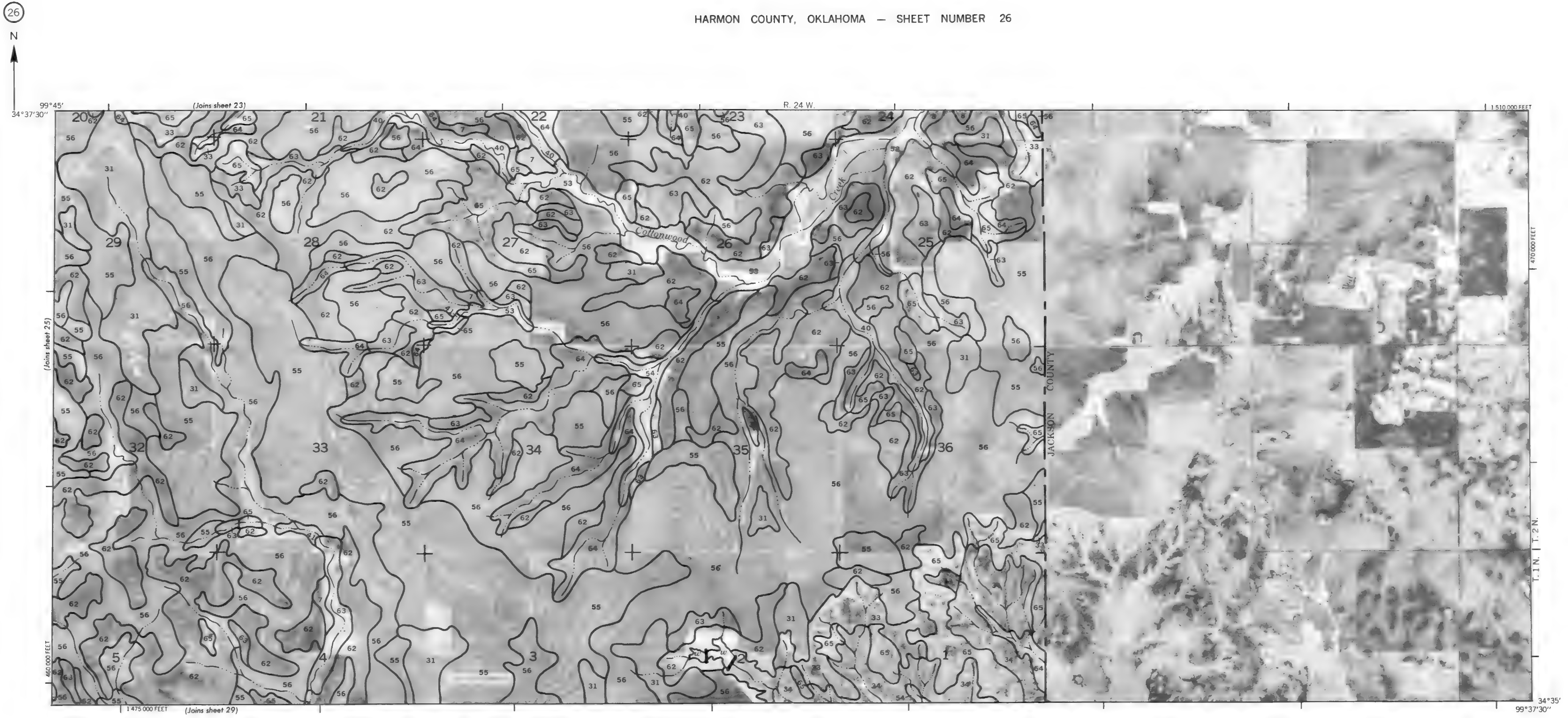
5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24 000

N

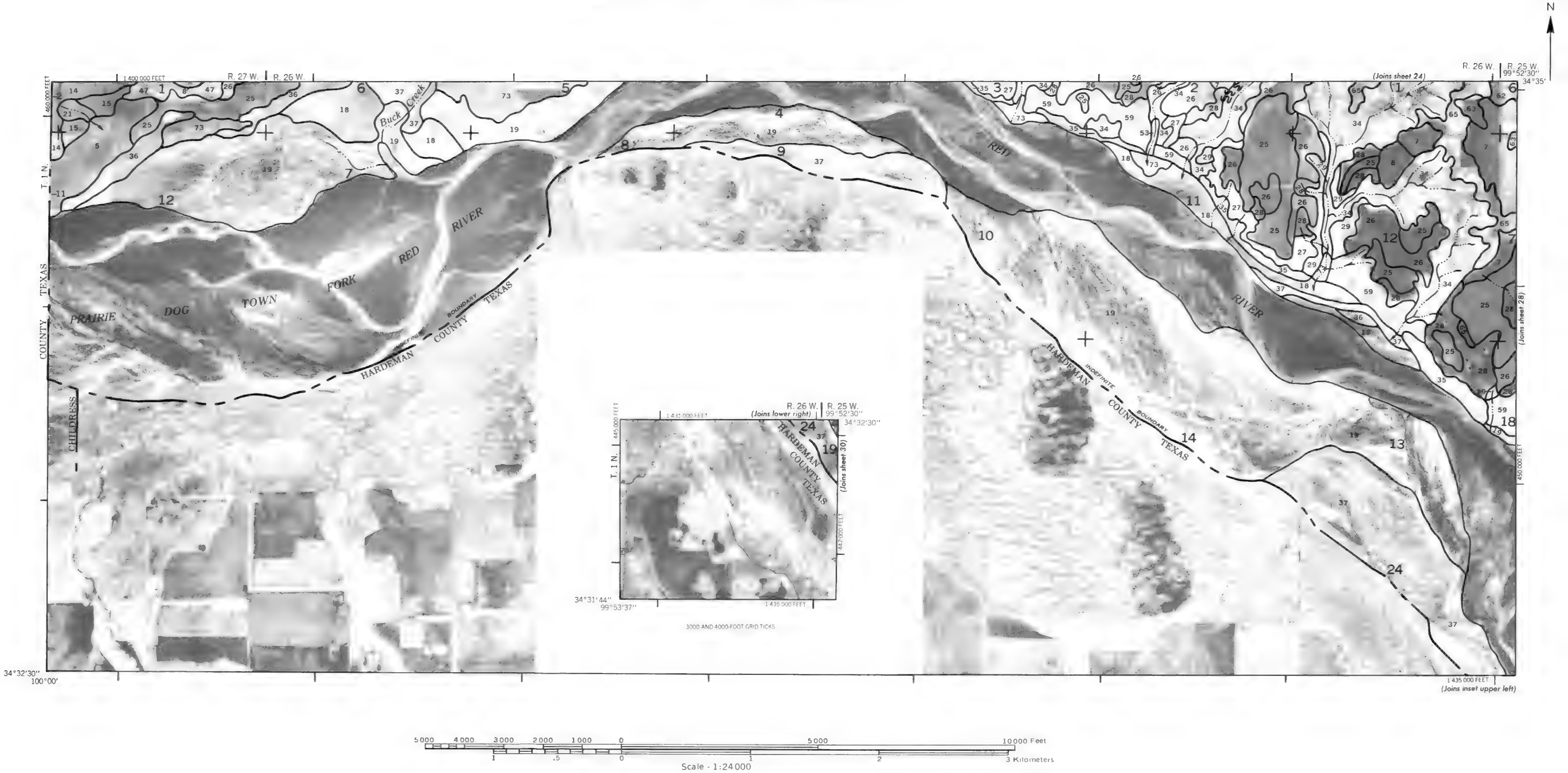

R. 25 W.
R. 24 W.
(Joins sheet 22)
(Joins sheet 24)
(Joins sheet 26)
(Joins sheet 28)
T. 2 N.
T. 1 N.
99°45'
34°37'30"
34°35'
99°52'30"
1 440 000 FEET
1 470 000 FEET
475 000 FEET
460 000 FEET
STAR
VALLEY
Intermittent
Sandy
Creek
5000
4000
3000
2000
1000
0
5000
10000 Feet
1
.5
0
1
2
3 Kilometers
Scale - 1:24 000



5000 4000 3000 2000 1000 0 5000 10000 Feet

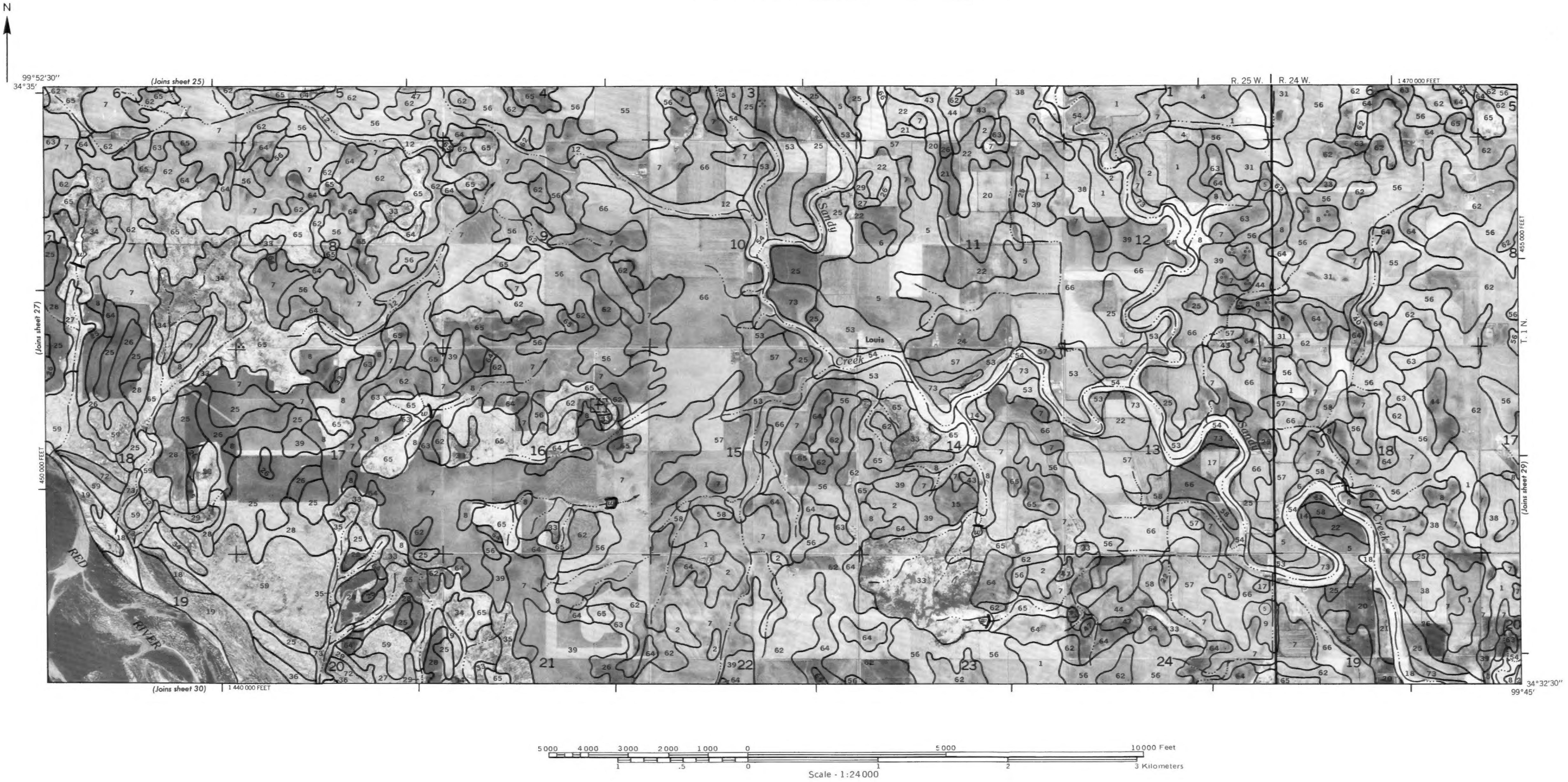
1 .5 0 1 2 3 Kilometers

Scale - 1:24 000


27
N
R. 27 W.
R. 26 W.
R. 25 W.
1 400 000 FEET
460 000 FEET
99°52'30"
34°35'
(Joins sheet 24)
Buck Creek
RED RIVER
PRAIRIE DOG TOWN FORK RED RIVER
HARDEMAN COUNTY TEXAS
INDEFINITE BOUNDARY
CHILDRESS COUNTY TEXAS
T. 1 N.
(Joins sheet 28)
450 000 FEET
1 435 000 FEET
(Joins inset upper left)
34°32'30"
100°00'
1 431 000 FEET
445 000 FEET
(Joins lower right)
34°32'30"
(Joins sheet 30)
442 000 FEET
34°31'44"
99°53'37"
1 435 000 FEET
3000 AND 4000-FOOT GRID TICKS
5000
4000
3000
2000
1000
0
5000
10000 Feet
1
.5
0
1
2
3 Kilometers
Scale - 1:24 000

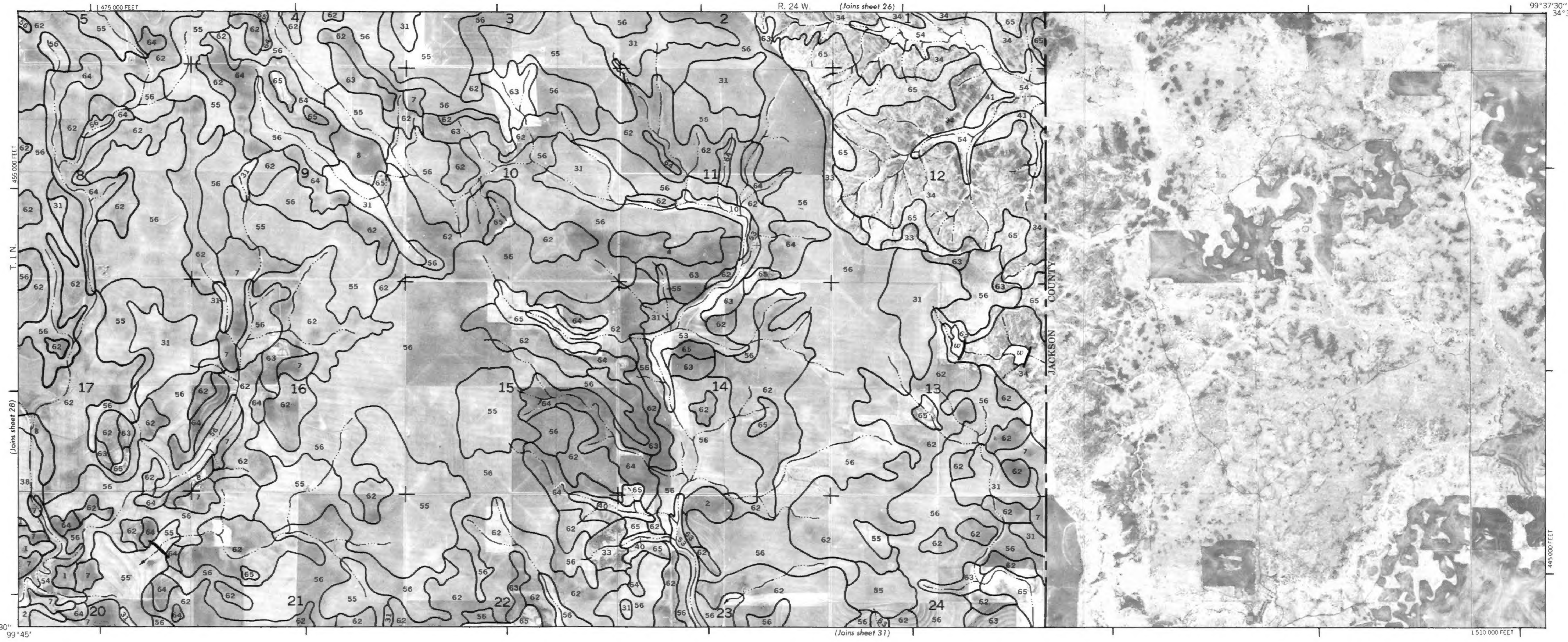
28

HARMON COUNTY, OKLAHOMA — SHEET NUMBER 28



29

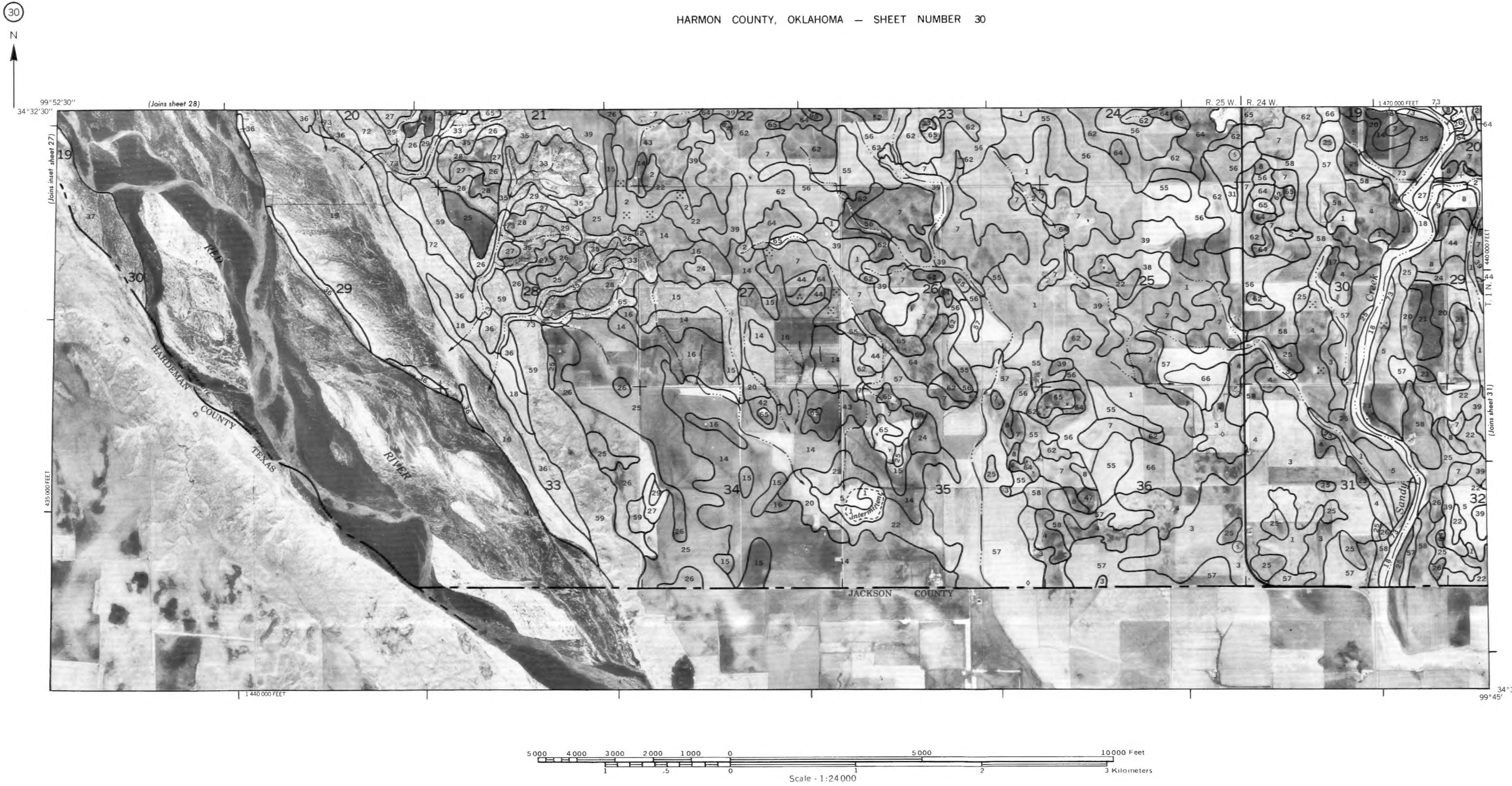
N

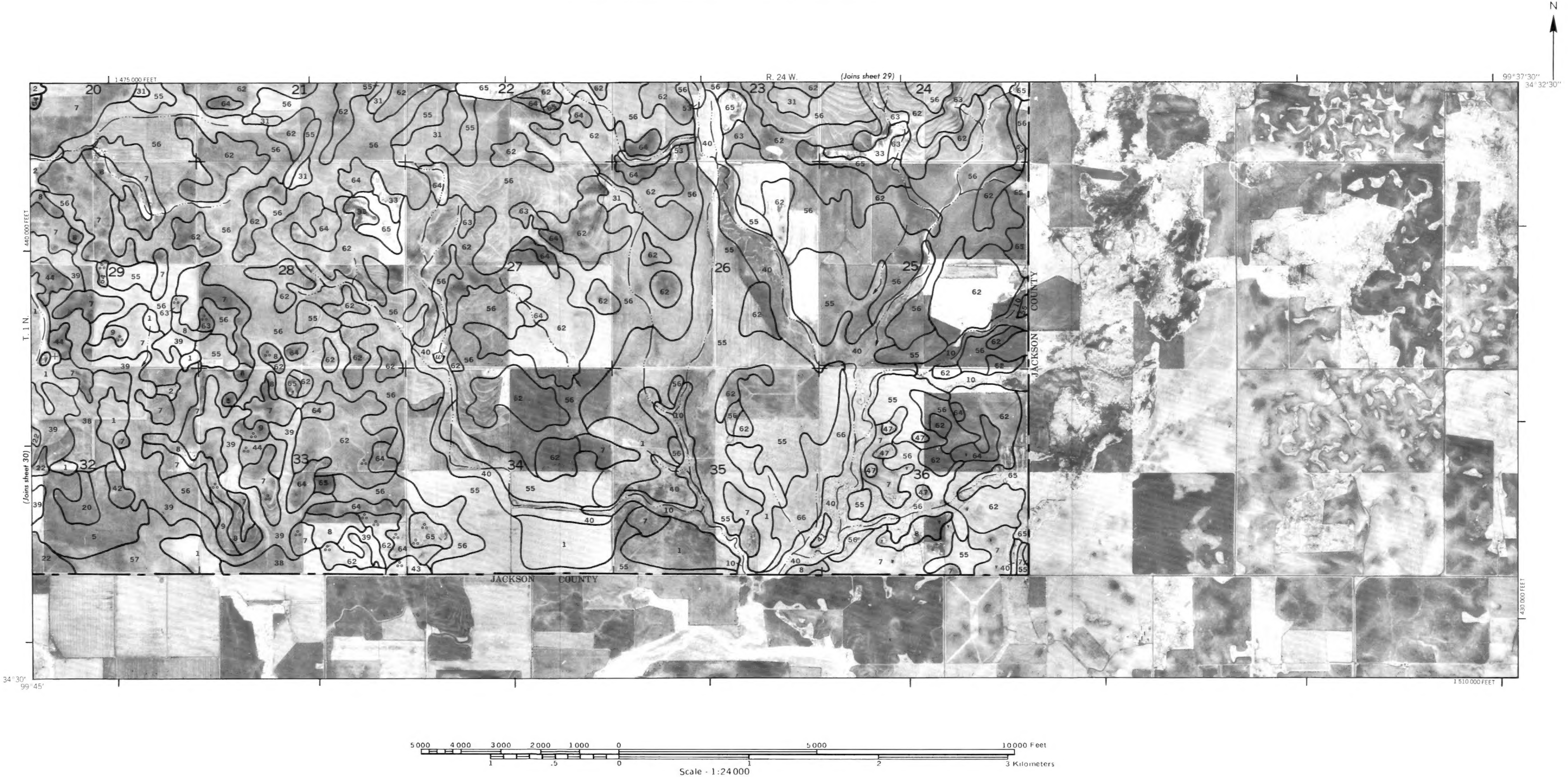


5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24000


30
N
99°52'30"
34°32'30"
(Joins sheet 28)
(Joins inset sheet 27)
(Joins sheet 31)
R. 25 W.
R. 24 W.
1 470 000 FEET
440 000 FEET
435 000 FEET
1 440 000 FEET
T. 1 N.
RED RIVER
HARDEMAN COUNTY TEXAS
JACKSON COUNTY
Sandy Creek
Intermittent
34°30'
99°45'
5000 4000 3000 2000 1000 0 5000 10000 Feet
1 .5 0 1 2 3 Kilometers
Scale - 1:24000


N
R. 24 W.
(Joins sheet 29)
(Joins sheet 30)
T. 1 N.
1 475 000 FEET
440 000 FEET
430 000 FEET
1 510 000 FEET
99°37'30"
34°32'30"
34°30'
99°45'
JACKSON COUNTY
JACKSON COUNTY
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet
1 .5 0 1 2 3 Kilometers
Scale - 1:24 000